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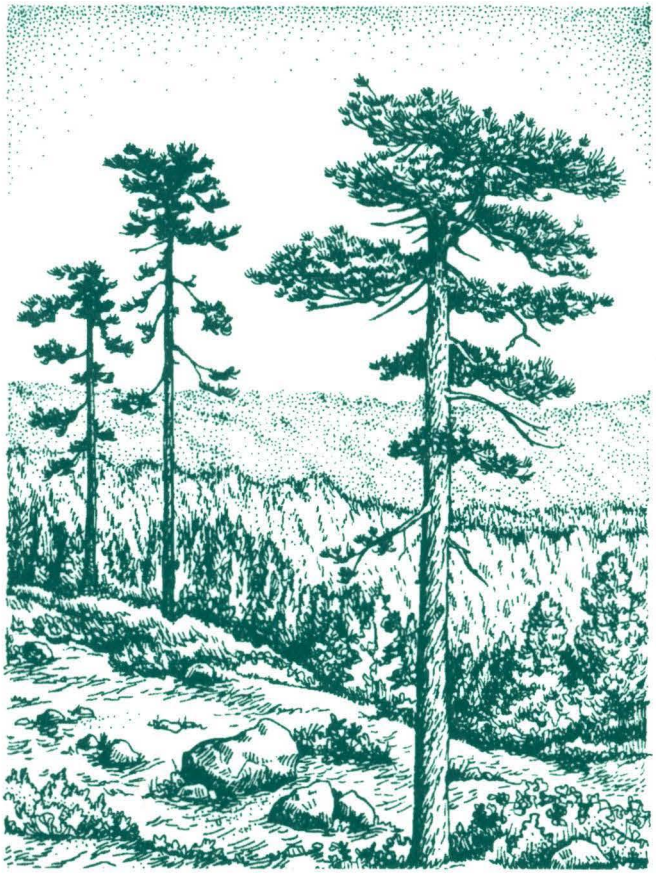
A Field Guide To Serpentine Plant Associations And Sensitive Plants In Northwestern California



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A Field Guide To Serpentine Plant Associations And Sensitive Plants In Northwestern California

RMO

Project Coordinator:
Sabrina L. Daniel

Authors:
Thomas M. Jimerson
Ecologist, Zone 1

Lisa D. Hoover
Forest Botanist

Elizabeth A. McGee
Assistant Ecologist

Gregg DeNitto
Plant Pathologist

R. Max Creasy
Forest Ecologist

Illustrations By:
Christina Ericksen

Photographs By:
Thomas M. Jimerson

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INTRODUCTION

The USDA Forest Service has changed its approach to management of the National Forests and Grasslands under its jurisdiction. This new strategy labeled **"Ecosystem Management"**, is based on ecological principles and is designed to conduct management and research with emphasis on maintenance of ecosystem process and function. To begin understanding ecosystem processes and functions requires a vegetation classification system. The Pacific Southwest Region of the Forest Service has begun a long term project to develop an ecological classification system for the 20 million acres it manages in California. This classification follows those developed by federal agencies throughout the United States. The California classification will describe potential natural plant communities in a hierarchical manner. This hierarchy includes series, subseries, and plant association classifications. Each level of the hierarchy are distinguished from the others by differences in species composition, soils, productivity, physiography, and expected response to management (Allen, 1987). These **potential natural vegetation** (PNV) units are used to analyze ecosystems through **coarse filte**r analysis. An example of coarse filter analysis is contained in the Six Rivers National Forest, Land Management Plan (USDA 1995). Here, management ranges of vegetation seral stages are identified for each of the primary vegetation series based on historical changes over the last 200 years. These seral stage ranges are used as a course filter sieve to assess the potential impacts of various management practices. Those projects that have the potential to alter a vegetation seral stage outside of what is sustainable are modified or dropped, while those that show no significant effects on sustainability can go forward. Managing within these ranges is our best professional judgement on how to manage for the maintenance of biological diversity. It is thought that maintaining representative amounts of various PNV types and their seral stages will protect viable populations of most species (85-90%) and maintain biological diversity (Noss 1987, Hunter 1991).

This field guide is one part of the California classification effort. It is our first attempt to integrate the PNV types (coarse filter approach) with the sensitive and rare plants found in these communities (fine filter approach). **Fine filter** analysis is used to analyze the species that occupy or makeup these communities. It follows the same logic as coarse filter analysis, except here we examine individual species for sustainability. This field guide describes plant associations found on serpentine parent materials within the Jeffrey pine (*Pinus jeffreyi*), Douglas-fir (*Pseudotsuga menziesii*), Port Orford cedar (*Chamaecyparis lawsoniana*), western white pine (*Pinus monticola*), and sugar pine (*Pinus lambertiana*) series, along with special habitats such as California Pitcher Plant bogs and serpentine barrens in Northwest California and relates the rare plant species found in them. When these PNV vegetation types are mapped, correlated with the rare taxa that occur there, and included into a geographic information system (GIS) it will be possible to measure the extent of potential habitat in order to develop management strategies that ensure their continued viability.

Serpentine Environments

Serpentine is a general term that refers to an environment influenced by the unique chemical composition of the parent rock . The ultramafic rocks, serpentinite and serpentinized peridotite, generally have high amounts of magnesium and iron and low levels of calcium. The soils and plants found in serpentine areas are heavily influenced by the chemical composition of these rocks. These rocks and the soils that develop from them will be referred to as

serpentine in this guide.

California has the highest concentration of serpentine rocks in North America. The largest area of serpentine rocks in California is found in the Coast Ranges and Klamath Mountains. Serpentine rocks comprise more than 1399 mi^2 in the Coast Ranges (Kruckeberg 1992). The Lassics, a small outlier of serpentine in the northern end of the Coast Ranges is included in this guide. The largest exposures of ultramafic rock in North America are found in the Klamath Mountains of Northwest California and Southwest Oregon (Irwin 1981). This extensive area of serpentine rocks includes the Josephine ophiolite and other ultramafic bodies of the Klamath Geologic Province. Most of the plant associations and rare plants described in this guide are found on the Josephine ophiolite.

The chemistry of these serpentine rocks is reflected in the soils, creating what has been referred to as the "serpentine syndrome" (Jenny 1980). This syndrome refers to the interaction between physical, chemical and biological factors influencing the soils and subsequently the plant life in serpentine areas. These soils typically have low amounts of available calcium and high amounts of magnesium and are depauperate in the essential nutrients, phosphorus, potassium and nitrogen. Like most soils, the development of serpentine soils, is influenced by several factors. Hans Jenny (1980) provided us with a model of soil-forming processes. He concluded that the primary soil forming factors are climate, organisms, topography, parent material, and time. As we will see throughout this field guide these factors continue to shape the soils we see and determine the vegetation types capable of existing on them. The unique chemical content of serpentine soils gives rise to distinct plant communities composed of species able to successfully compete in these harsh environments. In fact, the greatest concentration of **endemic** plant species restricted to serpentines is found in the Klamath and Siskiyou Mountains (Kruckeberg 1984).

Vegetation on serpentine sites changes dramatically when examined throughout California. In the southern part of California serpentine areas are dominated by chaparral, as we move north the chaparral is replaced by grasslands in the Sierra Nevada foothills and Coast Ranges. In the cooler, moist climate of Northwest California, mixed conifer forests dominate on serpentine soils. Forests on serpentine sites are often open and rocky with stunted trees and appear as islands in a dense sea of conifer forests. This contrasts sharply with the dense, rapidly growing stands on non-serpentine soils that surround these sites.

Area covered by this guide

The serpentine plant associations described in this guide are found in the western portion of the Klamath Mountains Section and in the northern portion of the Northern California Coast Range Section (Bailey and others 1994). This area includes both the Klamath and Siskiyou mountain ranges as well as the North Coast Ranges. The northern boundary of the guide is the Oregon border. The southern boundary is the Lassics peak area in Southern Humboldt county. These serpentine areas are found within the Six Rivers and Klamath National Forests. On the Six Rivers National Forest this includes the entire Smith River National Recreation Area and parts of the Lower Trinity, Orleans, and Mad River ranger districts. This area also includes parts of the Ukonom, Salmon River, and Happy Camp ranger districts on the Klamath National Forest (figure 1).

Sampling Strategy

Potential natural plant communities are analyzed using soils and environment characteristics and combined with management implications to establish plant associations. The potential natural plant community is the community that would

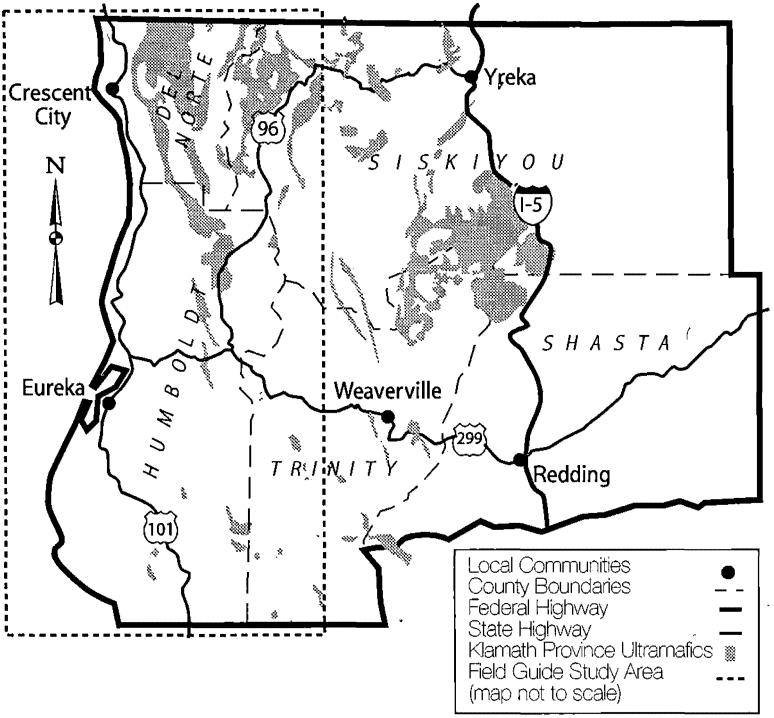


Figure 1. Map of the serpentine areas of northwestern California that are covered in this guide.

become established if all successional sequences were completed without interference by humans or drastic environmental changes. Natural disturbances are part of potential natural community development. This includes the introduction of naturalized non-native plant species (FSM 2060). Using this definition, our goal is to find and describe late seral, undisturbed, self-reproducing plant communities in conjunction with soils and environment variables.

Sampling Methods

This study was conducted in conjunction with the ecosystem classification program (Allen 1987) being conducted on the Six Rivers and Klamath National Forests. Late seral stage stands were primarily selected as study sites. Stands were located through a review of geology, timber type (USDA 1976), and vegetation maps (USDA 1995), and verified through aerial photo analysis and ground reconnaissance. Sample stands were selected using the methodology of Pfister and Arno (1980). Sampling methods generally followed those described earlier (Hall 1970; Moir and Ludwig 1983; and Allen and Diaz 1986). Sample plot locations were restricted to forested stands with homogeneous vegetation, seral stage, soils, geology, and landform (Pfister and Arno, 1980). Sample sites were selected after a review of the information on these factors and an extensive aerial photo and ground reconnaissance of the area. Plot size was 0.1 acre for herbs, graminoids, and understory trees and of variable radius for shrubs and overstory trees (Bitterlich 1947).

For each plot the following location information were recorded: plot number, national forest, ranger district, forest map number, forest compartment, township,

range, section, latitude, latitude minutes, longitude, and longitude minutes.

The physical environment was defined by elevation, aspect, percent slope, distance from the Pacific Ocean, landform (general topographic characterization), micro-position (position of the plot on the slope), horizontal micro-relief (slope shape parallel to the contours), vertical micro-relief (slope shape across the contours), bare ground percent, surface gravel percent, surface rock percent, potential annual radiation (total annual radiation received for a given aspect, slope and latitude) (Frank and Lee 1966), transformed aspect transformed to a linear variable from 1-8) (Lewis 1982), and radiation index (ratio of total annual radiation on a given aspect and slope to total annual radiation received on a flat surface for a given latitude) (Frank and Lee 1966). Radiation index is used in the plant association environment description as an indicator of potential surface temperature.

At each site, a soil pit was dug to a maximum depth of 40 inches or to bedrock. For each pit, data were recorded on: percent surface litter cover, litter thickness, parent material, parent material origin, total soil depth (to a maximum of 40 inches), rootability (whether the soil can be penetrated by roots), A horizon thickness, A horizon texture (using texture by feel), percent A horizon coarse fragments (using 2mm sieved soil samples), A horizon color (hue, value, and chroma using Munsell color charts) (Munsell 1975), subsurface texture, percent subsurface coarse fragments, subsurface color, soil drainage class, available water holding capacity (AWC) for the top 20 inches of soil, soil name (classified to family), pH of the surface horizon (using a Hellige-Truog Soil Reaction Tester), and pH of the subsurface horizon.

Ocular estimations of total percent cover were recorded at each plot, for moss, forbs, graminoids, shrubs and trees. All plants were identified to species where possible (nomenclature follows Munz 1973 and Hickman 1993), voucher specimens are stored at the Humboldt State University Herbarium. Abundance was recorded for the herbaceous and graminoid layers only (Allen and Diaz 1986). Estimates of tree height and standing basal area (basal area factor 10, 20 or 40) were recorded at three points per plot using a Speigel relaskop. In addition, diameter at breast height (dbh), total tree age, 10 and 20 year radial growth were recorded for a minimum of one dominant tree per point.

Initial classification was accomplished through the use of the polythetic divisive classification technique Two-way Indicator Species Analysis, [TWINSPAN] (Hill 1979). Polythetic devisive techniques have a theoretical advantage over agglomerative techniques since all available information is used to make the topmost decisions. TWINSPAN requires species cover values to avoid unacceptable rates of misclassification (Gauch 1984). It uses information on all species to group the plots based on similarity of species cover values. The data are first ordinated by reciprocal averaging with the extremes positioned at the polar ends. The samples are then divided into 2 clusters and the process is repeated until some minimum group size is achieved (Gauch 1984). This minimum group adds an element of subjectivity to the classification. This subjectivity can be reduced by applying the "stopping rule" of Hill (1980). Gauch (1984) recommends TWINSPAN because it is effective, robust, uses the original data in the classification rather than a similarity or dissimilarity index, integrates both samples and species, and places most similar samples together. One requirement of classification is that it must have heterogeneous communities to work, because some statistical programs will classify even a random data set (Ludwig and Reynolds 1988). TWINSPAN works best when paired with an ordination technique like the indirect gradient analysis tool, detrended correspondence analysis (DECORANA)

(Hill 1979) and the direct gradient analysis tool, canonical correspondence analysis (CANOCO) (Ter Braak 1986) described below.

The classification was then refined using the ordination technique, DECORANA. DECORANA is a detrended form of reciprocal averaging that also uses species cover. It is an objective, effective, robust community centered ordination technique that is particularly effective with heterogeneous data (Gauch 1984). It ordinates both species and sample units and can be used to identify outlier plots and species, and to identify plant association relationships. DECORANA develops a single ordination space partitioning. The DECORANA scores (DCA) can be regressed with environmental variables to identify the underlying environmental meaning of the ordination axes. Multiple regression analysis (Neter and others 1983) is used here to predict change and uncover environmental meaning in ordination scores.

CANOCO was used next to refine the classification. CANOCO is an extension of DECORANA, it is a direct gradient analysis technique designed to discover how a multitude of species respond to external environment variables (Ter Braak 1992, Palmer 1993).

The vegetation classification was further refined with Stepwise Discriminant Analysis (Jennrich and Sampson, 1985). Discriminant analysis forms linear combinations of the independent variables and uses them to classify cases into groups (Norusis 1992). Discriminant analysis is used to test membership in each group identified above and to identify the discriminating species and environmental variables. It identifies plots that are misclassified through posterior probabilities of group membership and lists the variables correlated with each discriminant function. The classification described in this guide should be considered a first approximation. The classification may change in the future as new information is added.

The program Forest Inventory Analysis (FIA) (USDA 1986), was used to analyze the tree data. Information generated by these programs included; standing cubic volume, cubic volume growth, basal area, basal area growth, site class, and trees per acre by species and dbh class. The statistical package SPSSPC+ (Norusis 1992) was used to develop descriptive statistics (mean, standard deviation, standard error), and to calculate stand density index (SDI) (Reineke 1933).

The correlations between the rare plants and the plant associations/special habitats were established using GIS overlays of rare plant occurrences with subsequent site visits to verify GIS results, population reports from the 1994 and 1995 field seasons, review of ecology plot data, and review of reports conducted on specific areas or species for the Forest (Nelson 1979, Renner 1985, Keeler-Wolfe 1986, Dubendorfer 1987, Wunner 1991 and McGee-Houghton 1995). The associations or special habitats listed are not necessarily exhaustive, but represent what we have observed to date. As we begin collecting information on plant associations and special habitats during our rare plant surveys as a matter of procedure, we will learn more about the fidelity of a species to certain associations.

Climate

The serpentine areas discussed in this field guide extend from 5 miles to 35 miles from the Pacific Ocean and ranged in elevation from 1800 feet to over 6000 feet above sea level. Air temperature and precipitation within this area are primarily influenced by proximity to the coast and elevation. Temperatures are moderate and seasonal temperature differences are low along the coast compared to inland areas. For example, at the immediate coast, mean monthly temperatures differ by

only 10°F between summer (42°) and winter months (55°). Twenty six miles inland, mean monthly temperatures can differ by 28°F between January (37°) and July (66°) (Dames and Moore 1982). Temperatures during the summer months are in the 60's and high 70's near the coast and in the 80s and 90s inland. During the winter, coastal temperatures are in the 40s and inland temperatures are in the 30s or sometimes the 20s. At higher elevations temperatures are 10 to 15 degrees cooler (Elford and McDonough 1974). Precipitation in this area is generally high due to the effects of elevation and terrain (Albert 1979). Most precipitation is the result of winter storms from the Pacific. As this moist air rises over the mountains rainfall intensity and amounts increase. Rainfall can be as high as 120 inches in some of these mountainous areas. Most areas over 3000 feet receive 70 inches or more precipitation a year (Elford and McDonough 1974). There is a definite wet and dry period in this area with sometimes 65% of the rainfall coming during the late fall and early winter months of Novermber to February. Precipitation in the form of snow can be found at high elevation sites. Thirty-five to forty inches and sometimes up to 150 inches of snow is found in the mountains during the winter months.

Geology

In this section an explanation of the origin of the serpentine rocks, peridotite, serpentinized peridotite, and serpentinite will be given, followed by an overall view of the geologic setting of the guide area.

Peridotite (an igneous ultramafic rock primarily composed of olivine and other mafic minerals) generally originates as the basement rock of oceanic crust. Oceanic crust is formed at oceanic spreading centers, found at mid-ocean ridges, back arc basins, fore arc basins or small ocean basins (Coleman and Jove 1992). This oceanic crust has been incorporated into the continent through plate tectonics processes that have been ongoing for millions of years. As the ocean plate and continental plate move toward each other, most of this ocean crust is subducted underneath the continental plate. Some of this crust, however, is pushed up toward the ocean surface during subduction and is accreted to the continent. The ocean crust emplaced against the continent is called ophiolite. Ophiolites consist of layers of rock that represent fragments of formally intact oceanic crust and mantle. The layers of an ophiolite consist from base to top of peridotite, gabbro, sheeted diabase dikes, pillow lavas, and pelagic sediments. The peridotite is usually the thickest layer of an ophiolite and is invariably serpentinized (Malpas 1992).

The serpentinization process involves the hydrothermic alteration of peridotite to the mineral serpentine. Specifically the mineral, olivine, found in peridotite is altered to the hydrated ferro magnesium silicate, serpentine. This process involves large amounts of water and moderate temperatures. During this process calcium in the original rock is released and iron can be bound in the mineral magnetite (Coleman and Jove 1992). Serpentinization takes place as the rocks are emplaced against the continent and during periods of uplift, in fracture and shear zones on the continent. The rocks that are serpentinized are distinct from unaltered peridotite. The mineral serpentine has a grey-green color with a platy, smooth texture. Peridotite has a dark color and is more coarse textured with a higher surface area. Within the peridotite layer there are also partially serpentinized rocks called serpentinized peridotite and rocks that are greater than 50% serpentinized that are called serpentinite.

Fragments of formally intact ophiolite suites as well as complete ophiolites are found throughout the Klamath Mountains and Coast Ranges geologic provinces. Peridotite, serpentinized peridotite, and serpentinite are the primary rocks

exposed within these ophiolites. Four subparallel exposures of peridotite, each younger in sequence from east to west are found in the Klamath Mountains (Irwin 1981). The youngest ultramafic unit is the Josephine ophiolite and the oldest is the Trinity ophiolite. The Trinity ophiolite is the largest unit of ultramafic rock found in the Klamath Mountains. Vegetation sampling is ongoing in the Trinity ophiolite and a future updated version of this guide will include vegetation types that are found in this area. The Josephine ophiolite has been influence by other geologic processes since its emplacement onto the continent. Increased erosion during a period of geologic inactivity in the Miocene, has resulted in a series of flat topped ridges in the area of the western Klamath Mountains, called the "Klamath peneplain" (Diller 1902, Irwin and Hotz 1981). Several plant associations are found in relationship with these flat-topped ridges.

The Coast Range ophiolite extends far south of the guide area, however, the Lassics an outlier of this ophiolite is included within the guide boundaries. This outlier consists of highly serpentinized and sheared ultramafic rocks surrounded by mafic volcanic rocks and Franciscan metasedimentary rocks (Kaplan 1984). The Lassics area includes three peaks, Mt. Lassic, Red Lassic, and Black Lassic. The main exposure of ultramafic rocks in the Lassics area , is found on Mt. Lassic and on the northern slopes of Red Lassic.

The Soil

The physical and chemical properties of serpentine soils are the result of the weathering of the parent rock. The weathering of serpentinized peridotite or serpentinite involves the disintegration of the primary minerals, olivine, pyroxene, and serpentine to secondary clay minerals. The clay minerals typically found in serpentine soils in Northwestern California are iron-rich montmorillinites (Wildman and others 1968). Montmorillinites are high expanding clays with relatively high cation exchange capacities (Kruckeberg 1984, Brady 1990). Some serpentine soils have relatively high available water holding capacity due to the formation of these clays (Kruckeberg 1984).

The chemical weathering of serpentinized peridotite results in soils rich in magnesium, silica, and iron and low in calcium, potassium, and aluminum. Serpentine soils also typically have high pH values and high concentrations of the heavy metals, nickel, chromium, and cobalt. The availability of these heavy metals to plants can depend upon the degree of serpentinization of the parent rock. Unaltered peridotite or slightly serpentinized peridotite can developed to laterite soils in areas with high rainfall (Coleman and Jove 1992). Laterite soils are leached red to yellow soils with low amounts of silica and high amounts of aluminum. These soils are associated with mining activity because of their high concentration of nickel and chromium. Soils developed from serpentinite do not produce high amounts of nickel because they are more resistant to weathering and leaching of nickel and iron (Coleman and Jove 1992).

A total of over 300 soil pits were described in this study of serpentine plant communities. The characteristics of these soils are summarized in Appendix III at the back of this guide. Over 70 percent of these soils were moderately deep (20-40 in) to deep (>40 in) and only 23 percent were shallow. Eighty percent of these soils had a greater than 36% volume of rock fragments in the A horizon. This high rock fragment content contributed to moderate (2.4") to low (1.2") available water holding capacity (AWC) for over 50% of these soils. The pH of these soils was consistently neutral (6.6) to slightly alkaline (7.8) for both the surface and subsoil. Six percent of these soil profiles were strongly acidic (5.5) at the surface. This strong acidity may be attributed to the high amount of organic matter in serpen-

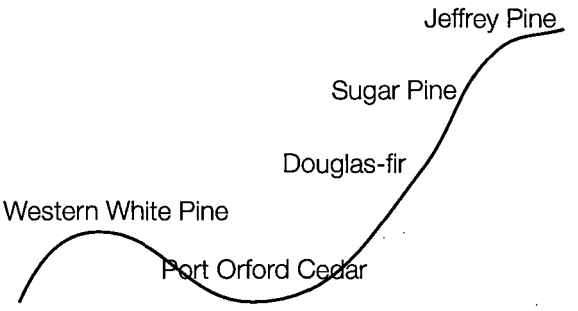


Figure 2. Relative topographic position of the primary vegetation series on serpentine sites.

tine bogs and plant communities in the lower slope positions. The specific descriptions of the plant associations in this guide will indicate how these differences in soil characteristics are reflected in the vegetation.

Serpentine soils in California have been classified in the orders Entisol, Inceptisol, Alfisol, and Mollisol (Alexander 1994). All of these soil orders are represented in the area covered by this guide. These soils were primarily Inceptisols representing 62 percent of the soil profiles. Seven percent of the profiles were Entisols and the remaining soils were Alfisols (24%) and Mollisols (7%). For the family classification 49 percent of the soils had a mixed mineralogy class and 46 percent were serpentinitic. Most of these soils (75%) were identified as having a mesic temperature regime with only 25 percent identified as frigid.

The Vegetation

Extensive ecology plot sampling (300+ plots) on sites dominated by serpentine parent material identified five potential natural vegetation (PNV) series and two existing vegetation series in the study area. These were the Port Orford cedar, Douglas-fir, Jeffrey pine, sugar pine and western white pine PNV series and the lodgepole pine (*Pinus contorta*) and knobcone pine (*Pinus attenuata*) existing vegetation types. They are found arrayed along a topographic/moisture gradient such as the one displayed in figure 2 and are described below.

The **Port Orford Cedar series** was found in streamside and lower one-third slope positions, with linear, undulating, and concave horizontal micro-relief and linear, undulating vertical micro-relief. Moisture conditions here were the highest of all topographic positions. Elevation ranged from 1500 to 5180 feet, with moderately steep slopes (mean=32%). All aspects were included, however the effects of southerly aspects tend to be modified by topographic shading provided by the adjacent slopes.

Soils in the Port Orford Cedar series were derived from serpentinite and peridotite parent rocks, and were primarily classified as loamy skeletal, mixed or serpentinitic, mesic or frigid, Typic Xerochrepts. They were included in the Inceptisol (78%), Alfisol (10%), and Entisol (10%) orders. Soil depth was mainly moderately deep and deep, with gravelly and very gravelly loam textures. Surface pH averaged 6.5, second lowest of all series and indicates a moderation of the normally basic soils derived from these parent materials. This is probably related to the leaching of the upper horizons and the incorporation of organic material which tends to reduce soil pH. Subsurface pH averaged 7.0, second highest of all series. This large difference in pH may be related to the reducing conditions that

are often present in the lower horizons on these wet sites. Available water holding capacity (AWC) was the highest of all series (3.2 inches) despite having the highest mean A horizon coarse fragment content of 39%. Available water continuously recharges the soils in the Port Orford Cedar series through both surface and subsurface flows.

Species composition in the Port Orford Cedar series is described by layer. The overstory had the highest mean cover of all series, 72%. It was dominated by Port Orford cedar with Douglas-fir as a codominant species. Sugar pine and white fir (*Abies concolor*) were often present as associate species, with western white pine on cool high elevation sites and incense cedar (*Calocedrus decurrens*) present on warm sites. The understory was represented by the same species mix along with Pacific yew (*Taxus brevifolia*). The shrub layer was moderately dense with a mean cover of 37%. It was dominated by huckleberry oak (*Quercus vaccinifolia*), with red huckleberry (*Vaccinium parvifolium*), western azalea (*Rhododendron occidentale*), Pacific serviceberry (*Amelanchier alnifolia*), wood rose (*Rosa gymnocarpa*), and pacific blackberry (*Rubus ursinus*) as associate species. The herb layer was diverse, but of low cover with a mean of 10%. It contained a variety of species including beargrass (*Xerophyllum tenax*), western prince's pine (*Chimaphila umbellata* var *occidentalis*), iris (*Iris* sp.), rattlesnake plantain (*Goodyera oblongifolia*), starflower (*Trientalis latifolia*), twinflower (*Linnaea borealis*), and common whipplea (*Whipplea modesta*). The grass and sedge layer were lacking, with a mean cover of 1%, along with the sugar pine series it had the lowest cover of all series. When present the grass/sedge layer was dominated by sedges (*Carex* spp.).

The **Douglas-fir series** replaces the Port Orford Cedar series upslope and was found on mesic sites with somewhat less moisture. It was found in upper, middle, and lower one-third slope positions, with linear, undulating, and concave horizontal micro-relief and linear, undulating vertical micro-relief. Moisture conditions here were lower than the Port Orford cedar series, but higher than all other topographic positions. Elevation ranged from 610 to 4440 feet, with the steepest mean slope of all series (45%). All aspects were included with sites generally warmer and more exposed than the Port Orford Cedar series.

Soils were derived from serpentinite, peridotite, and mafic parent rocks. They were primarily classified as loamy-skeletal and fine-loamy, mixed and serpentinitic, mesic, Typic or Dystric Xerochrepts or Haploxeralfs. They were included in the Inceptisol (68%), Alfisol (24%) and Entisol (5%) orders. Soil depth ranged from shallow to deep, with gravelly, very gravelly, and gravelly silt loam textures. Surface soil pH averaged 6.4, while subsurface pH had a mean of 6.7 both were the lowest of all series. This tends to indicate higher soil development on these mesic sites. Available water holding capacity (AWC) was low (1.9 inches) due to high A horizon coarse fragments (35%).

Species composition in the Douglas-fir series is described by layer as follows. The overstory had the second highest mean cover of all series, 65%. It was dominated by Douglas-fir, with incense cedar, sugar pine, Pacific madrone (*Arbutus menziesii*), Jeffrey pine and tanoak (*Lithocarpus densiflorus*) often present as associate species. The understory was represented by the same species mix along with canyon live oak (*Quercus chrysolepis*) and California bay (*Umbellularia californica*). The shrub layer was moderately dense with a mean cover of 38%. It was dominated by huckleberry oak, with poison oak (*Rhus diversiloba*), red huckleberry, dwarf Oregon-grape (*Berberis nervosa*), wood rose, Pacific serviceberry, and creeping pygmy hollygrape (*Berberis pumila*) as associate species. The herb layer was diverse, but of low cover with a mean of 10%. It contained a

variety of species including western modesty (*Whipplea modesta*), iris, beargrass, western prince's pine, swordfern (*Polystichum munitum*), rattlesnake plantain, starflower, white hawkweed (*Hieracium albiflorum*), little prince's pine (*Chimaphila menziesii*), and western Solomon's seal (*Smilacina racemosa* var. *amplexicaulis*). Grass layer cover varied by plant association, with mean cover of 19%, along with the Jeffrey pine series it had the highest cover of all series. It was dominated by California fescue (*Festuca californica*) and western fescue (*Festuca occidentalis*).

The **western white pine series** was found on ridgetop and upper one-third slope positions on cool sites as a result of their proximity to the Pacific Ocean. Horizontal and vertical micro-relief were linear and concave. Moisture conditions here were higher than the adjacent sugar pine series as a result of heavy snowpacks, and micro-relief. Elevation ranged from 1800 to 4100 feet, with high surface rock, averaging 46%, moderate mean slope (27%). All aspects were included with sites generally cooler than the adjacent sugar pine series.

Soils in the western white pine series were derived from serpentinite and peridotite parent rocks, and generally showed more development than the sugar pine series. They were primarily classified as loamy-skeletal and fine-loamy, serpentinitic, frigid, Typic Haploxeralfs. They were included in the Alfisol (57%), Inceptisol (27%), and Entisol (13%) orders. Soil depth ranged from moderately deep to deep, with gravelly loam, very gravelly loam, and loam textures. Surface soil pH averaged 6.8, while subsurface pH had a mean of 7.1, both were the highest of all series. This is probably due to low soil development on these cool sites. Available water holding capacity (AWC) was second highest of all series (2.4 inches), A horizon coarse fragments averaged 33%.

Species composition in the western white pine series is described by layer as follows. The overstory had the second lowest mean cover of all series, 43%. It was dominated by western white pine in late seral stands and lodgepole pine in early seral stands, with Douglas-fir, sugar pine, and knobcone pine often present as associate species. The understory was represented by the same species mix with knobcone pine only of rare occurrence. The shrub layer was the dominant layer in this series. It was dense with the second highest mean cover of all series 76%. It was dominated by huckleberry oak, red huckleberry, dwarf tanbark (*Lithocarpus densiflorus* var. *echinoides*), and pinemat manzanita (*Arctostaphylos nevadensis*), with coffeeberry (*Rhamnus californica*), common juniper (*Juniperus communis*), California bay, Pacific rhododendron (*Rhododendron macrophyllum*), oceanspray (*Holodiscus discolor*), dwarf silktassel (*Garrya buxifolia*), creeping Oregon-grape (*Berberis repens*), whiteleaf manzanita (*Arctostapylos viscida*), Pacific serviceberry, western azalea, and squaw carpet (*Ceanothus prostratus*) as associate species. The herb layer had the highest cover of all series 17%, but lacked herbaceous diversity. It was dominated by beargrass and often contained western modesty, iris, white veined wintergreen (*Pyrola picta*), starflower, and California harebell (*Campanula prenanthoides*). Grass layer cover was among the lowest of all series, with mean cover of 3%. It included California fescue, Idaho fescue (*Festuca idahoensis*), and a variety of sedges.

The Douglas-fir series was replaced upslope by the **sugar pine series** on warmer, drier sites. It was found in upper one-third and ridgetop slope positions, with linear, convex horizontal micro-relief and linear, undulating vertical micro-relief. Moisture conditions here were lower than the Douglas-fir series. Elevation ranged from 2000 to 4800 feet, with moderate slopes of 27%. Aspects were primarily east, south and west, with selected plant associations on northeast slopes.

Soils were derived from serpentinite and peridotite parent rocks. They were

primarily classified as loamy-skeletal and fine-loamy, mixed or serpentinitic, frigid or mesic, Typic Xerochrepts or Haploxeralfs. Soil depth ranged from shallow to deep, with gravelly loam, sandy loam, and silt loam textures. Surface and subsurface soil pH averaged 6.7. Available water holding capacity (AWC) was the lowest of all series (1.9 inches).

Species composition in the sugar pine series is described by layer as follows. The overstory had the lowest mean cover of all series, 33%. It was dominated by sugar pine and Douglas-fir, with western white pine, lodgepole pine (in early seral stands), chinquapin (*Castanopsis chrsophylla*) and knobcone pine often present as associate species. Chinquapin was most often present as an understory tree or shrub in this series. The understory was represented by the same species mix with white fir replacing knobcone pine on many sites. The shrub layer was the dominant layer in this series as it was in the western white pine series. It was dense with the highest mean cover of all series 77% and contained many of the same species. It was dominated by huckleberry oak, red huckleberry, dwarf tanbark, and pinemat manzanita, with coffeeberry, common juniper, dwarf silktassel, creeping Oregon-grape, whiteleaf manzanita, greenleaf manzanita (*Arctostapylos patula*), Pacific serviceberry, Pacific rhododendron, sadler oak (*Quercus sadleriana*), salal (*Gaultheria shallon*), and squaw carpet as associate species. The herb layer had a relatively low cover of 12%, and lacked herbaceous diversity. It was dominated by beargrass and often contained western modesty, iris, white veined wintergreen, and bracken fern (*Pteridium aquilinum* var. *lanuginosum*). Grass layer cover was the lowest of all series, with mean cover of less than 1%. It occasionally included California fescue and a variety of sedges.

The sugar pine series was replaced upslope by the **Jeffrey pine series** on xeric upland sites with somewhat less moisture. It was found in ridgetop and upper one-third slope positions, with linear, convex horizontal and vertical micro-relief. Moisture conditions here were generally the lowest of all series due to topographic positions. Elevation ranged from 920 to 6300 feet on sites with the lowest mean slope of all series (26%). All aspects were included on these warm, exposed sites.

Soils were derived from serpentinite and peridotite parent rocks. They were classified as loamy-skeletal or fine-loamy, mixed or serpentinitic, mesic or frigid, Typic or Dystric or Ultic, Xerochrepts or Haploxeralfs. They were included within the Inceptisol (60%), Alfisol (23%), Entisol (6%), and Mollisol (5%) orders. Soil depth ranged from shallow to moderately deep, with gravelly loam, loam, and very gravelly loam textures. Surface soil pH averaged 6.7, while subsurface pH had a mean of 6.9 both were the second highest of all series. This tends to indicate lower soil development on many of these exposed sites. Available water holding capacity (AWC) was variable (2.2 inches) due to soil depth and A horizon coarse fragments (28%).

Species composition in the Jeffrey pine series is described by layer as follows. Overstory cover was low with a mean cover of 48%. It was dominated by Jeffrey pine and incense cedar, with Douglas-fir, sugar pine, and white fir often present as associate species, occasionally Ponderosa pine replaces or mixes with Jeffrey pine. The understory was represented by the same species mix as the overstory. The shrub layer was variable, it ranged from very low to high cover, with a mean cover of 38%. It was dominated by huckleberry oak and pinemat manzanita, with coffeeberry, dwarf silktassel, creeping Oregon-grape, greenleaf manzanita, Pacific serviceberry, red huckleberry, oceanspray, and squaw carpet as associate species. The herb layer had a moderate mean cover of 12%, due to its open character. It was dominated by beargrass and often contained iris, white veined

wintergreen, white hawkweed, and western prince's pine as well as a host of rare species. Grass layer cover was the highest of all series, with mean cover of 19%. It was often dominated by Idaho and California fescue.

The **lodgepole pine and knobcone pine series** are described here as existing vegetation types based on their seral nature. The lodgepole pine series was extensive in the northern portion of the study area where it dominated early and middle seral stages within the western white pine and sugar pine series. These dense stands of small diameter, stunted trees, were often found to be over 100 years old and under 5 inches in diameter. The knobcone pine series was found in small stands distributed throughout the study area. Here, it dominated earlier seral stages in the Douglas-fir series and occasionally in the Jeffrey pine and sugar pine series.

Relationship to other classification systems in California

The USDA Forest Service classification effort is one of a number of vegetation classification systems found throughout California. Two of the more widely used classification systems are the Natural Diversity Data Base (NDDB) developed by Holland (1986) and the Wildlife Habitat Relationships (WHR) (Mayer and Laudenslayer 1988) used to assess resource value for wildlife. The California Native Plant Society (CNPS) is also in the process of publishing the Manual of California Vegetation (Sawyer and Keeler-Wolf in press). This manual describes all of the plant communities that have been identified (to date) throughout the state. Most of the series described in the serpentine guide corresponded to the plant communities characterized in the draft version of the Manual of California Vegetation. The sugar pine series and the serpentine barrens in this guide, are not described in the manual of California vegetation. A comparison between the series described in this guide to the Holland, WHR, and CNPS plant communities is shown in Table1.

Efforts have also been made to correlate with classification efforts in the region to the north of the guide area. The serpentines discussed in this guide also extend into southwestern Oregon. A preliminary classification of serpentine vegetation

Table 1. A comparison of the Klamath Province series described in this guide to CNPS, WHR, and NDDB vegetation classifications.

Klamath Province	CNPS	WHR	NDDB
Jeffrey pine	Jeffrey pine	Jeffrey pine/ Eastside pine	Northern Ultramafic Jeffrey pine
Douglas-fir	Douglas-fir	Douglas-fir	Upland Douglas-fir
Port Orford Cedar Forest	Port Orford Cedar	Douglas-fir	Port Orford Cedar
Western white pine	Western white pine	Klamath mixed conifer	Ultramafic western white pine
Pitcher Plant Bogs	Darlingtonia series	Wet Meadow	Bog and fen

types has been developed on the Siskiyou National Forest (Atzet 1984). The series described in the Siskiyou National Forest correspond to the series described in this guide, but the plant associations differ due to climatic and soil differences.

Species Richness

Whittaker (1960) described the Siskiyou and Klamath Mountains of northwest California as containing the most diverse vegetation communities found in California. Kruckeberg (1992) tells us that over 60 endemic plant species are found in this area. It has been speculated that these areas contain high species richness as well. This section will numerically quantify species richness and compare it by vegetation series found on the serpentine soils of northwest California.

Species richness is described as the total number of species encountered within the area of study. It is used here as a measure of biodiversity and is compared among the five vegetation series found on the serpentine soils of northwest California. The Jeffrey pine series had the highest number of species, 352 and the highest number of plots 123. The western white pine and sugar pine series had the lowest number of species 104 and 108, as well as the lowest number of plots 30 and 26 respectively. When mean species per plot was examined the Port Orford Cedar series had the highest number of species per plot 24.2, with Jeffrey pine the second lowest 21.3. What this points to is the inability to compare species richness between populations with unequal sample sizes. The statistical method rarefraction (Ludwig and Reynolds 1988) was selected to overcome this problem and provide for more accuracy and less bias than direct species richness comparisons. It computes an expected number of species, E(Sn), in a random sample of size, n, as the sum of the probabilities that each species will be included in the sample. Using the lowest common denominator of 500 individuals encountered in the Sugar pine series, we compare the expected number of species encounters E(Sn) for each series (Table 2). The results show that the Jeffrey pine series had the highest expected number of species, 170 in a sample size of 500 individuals. This is probably due to the open nature of many of the Jeffrey pine plant associations, which allows for a high diversity of microhabitats

Table 2. Plant species richness comparison by vegetation series.

	POC	DF	JP	WWP	SP
Overstory Trees	17	21	18	8	14
Understory Trees	15	20	18	10	14
Shrubs	43	48	55	22	29
Forbs	92	117	225	57	48
Grasses	11	15	36	7	3
Total Species	178	221	352	104	108
Number of Plots	61	78	123	30	26
Average Species/Plot	24.2	23.9	21.3	23.7	20.3
Individuals Encountered	1477	1866	2624	710	529
Rarefraction Expected Species E(Sn)	121	138	170	94	106

and leads to a greater number of forbs, and hence high species diversity. The Douglas-fir and Port Orford Cedar series were second and third highest in expected number of species, 138 and 121 respectively. These two series have the highest cover of overstory trees 65% and 72%, the lowest mean shrub cover 38% and 37%, and the highest amount of available moisture due to slope position. These factors also contribute an environment that is conducive to a high number of herbaceous species (Table 2). The western white pine and sugar pine series had the lowest expected number of species in a sample of 500 individuals, 94 and 106. While these series have relatively low mean tree cover 43% and 33%, they also have the highest mean cover of shrubs 76% and 77% respectively. This dense shrub layer reduces the amount of light reaching the forest floor and suppresses forb cover, thereby leading to low species richness.

In an earlier study comparing the Port Orford cedar, tanoak, Douglas-fir, white fir, and red fir series of northwest California, Jimerson and Creasy (1991), found the Port Orford Cedar series to have the highest species richness. In comparison with this study it appears that serpentine environments contain the highest species richness of the major forest vegetation types in northwest California.

Disturbance and Age Class Distribution

Natural disturbance in northwest California primarily takes the form of wildfire, with flooding, insects and disease playing a lesser role. The age class distributions displayed below are indicators of disturbance frequency by vegetation series. These frequencies are related to slope position and are specific to each series (Jimerson 1995).

The Port Orford Cedar series displays the lowest frequency of stand replacing wildfires due to its streamside and lower one-third slope positions where site conditions are more moist than upslope positions. The Port Orford Cedar series had its highest frequency of stands in the 326-375 age class (figure 3). Sixty eight

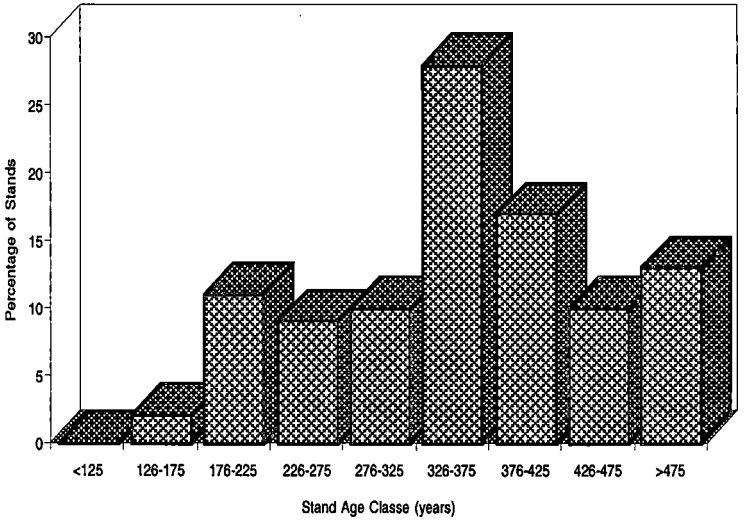


Figure 3. Percent of stands by age class category in the Port Orford Cedar series.

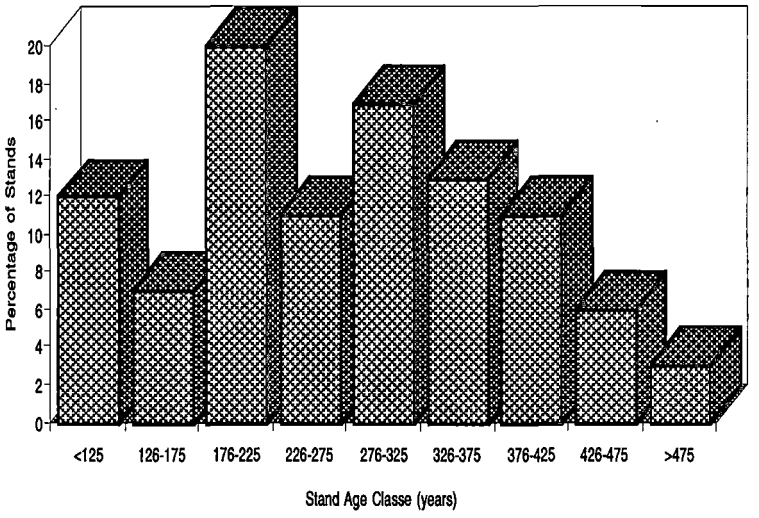


Figure 4. Percent of stands by age class category in the Douglas-fir series.

percent of the stands sampled in the Port Orford Cedar series were over 325 years stand age, while only 32% were less than 325 years.

Second lowest in stand replacing fire frequency was the Douglas-fir series, located just upslope from the Port Orford Cedar series on mesic sites. The highest frequency of stands sampled in the Douglas-fir series were found in the 176-225 and 276-325 age class categories (figure 4). As we can see in figure 4. most (81%) of the Douglas-fir stands were found in stands over 175 years stand age compared to just 19% below 175 years stand age.

The Jeffrey pine series begins a trend toward landscape dominance of younger stands due to its occurrence on drier sites. It had its highest frequency (21%) in stands less than 125 years of age (figure 5). The Jeffrey pine series, unlike the sugar pine and western white pine series, has a relatively even distribution of stands in all age classes. This distribution is dependent on plant association type and is related to a variety of slope positions and fuel production potentials. The sugar pine series had the second highest frequency of stand replacing wild fires due to its drier, upper slope positions. It was dominated by stands younger than 175 years (52%) (figure 6), with the rest of the stands found between 176 and 425 years stand age. The western white pine series had the highest frequency of stand replacing disturbance due to its dry ridgetop and upper one-third slope positions where lightning strikes with highest frequency. It included 70% of its stands in the < 175 year age classes (figure 7), with only 30% found between 176-325 years stand age. Knowledge of these age class distributions and their relationship to natural disturbance is paramount if we are to manage for healthy ecosystems similar to those that presently exist.

Insects and Pathogens

Native insects and pathogens are herbivores on trees and act as regulators of the forest. Their actions affect species composition and the amount of vegetation growing on a site. They recycle biomass, develop and provide wildlife habitat and food, and provide diversity locally and on a larger scale. They often times function as a stress agent on a tree, which can result in injury or mortality to the tree. This is especially true on less productive, serpentine sites. Nonnative insects and

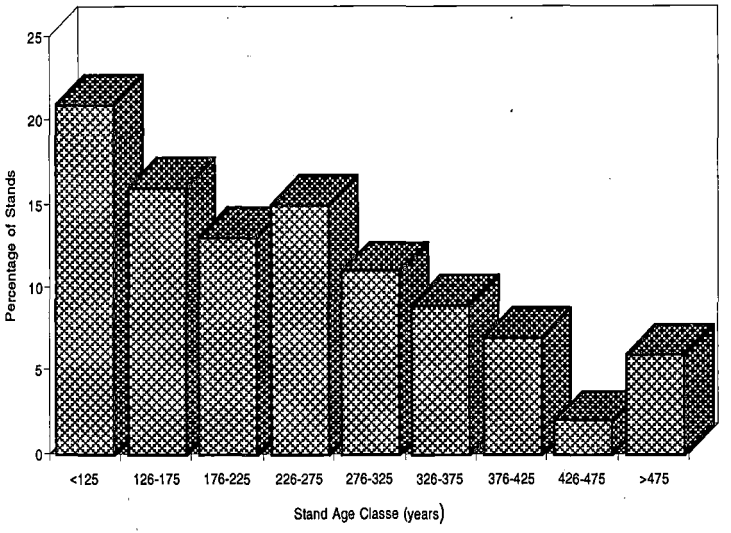


Figure 5. Percent of stands by age class category in the Jeffrey Pine series.

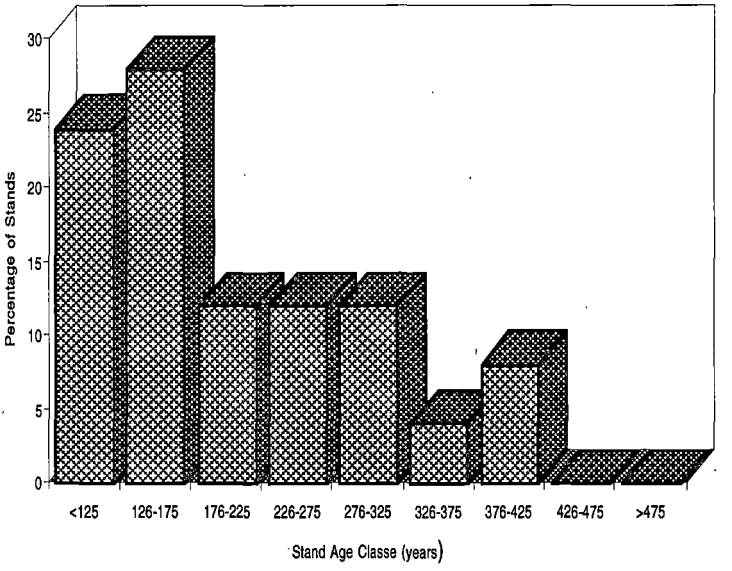


Figure 6. Percent of stands by age class category in the Sugar Pine series.

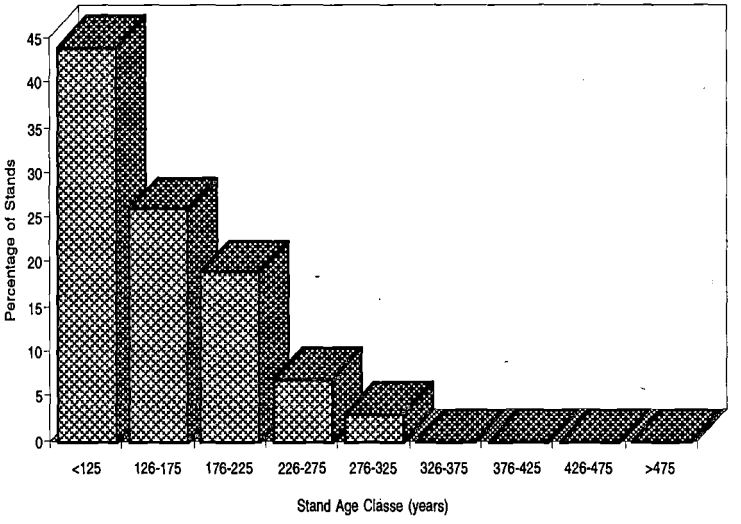


Figure 7. Percent of stands by age class category in the Western White Pine series.

pathogens have similar effects, but because they have not coevolved with their hosts, the impacts they cause can be much greater and ecologically damaging.

One group of pathogens that is commonly observed are dwarf mistletoes (*Arceuthobium* spp). These are flowering plants that are members of the Viscaceae. The principal species on serpentine sites in northwestern California are western dwarf mistletoe (*A. campylopodum*) on Jeffrey pine, western white pine dwarf mistletoe (*A. monticola*) on western white pine, and knobcone pine dwarf mistletoe (*A. siskiyouense*) on knobcone pine. These species are generally host specific, although they can occasionally or rarely infect nearby individuals of other species of the pine family. They infect twigs and branches and occasionally trunks of their host, obtaining water and nutrients through connections with the host xylem. These dwarf mistletoe species usually do not cause tree mortality, but weaken a tree sufficiently for bark or engraver beetles or wood borers to successfully attack and kill the tree.

Western dwarf mistletoe is common throughout the area of concern. Branch infections can produce a unique formation known as a witches' broom with time. These brooms are normally in the lower crown and appear as large, dense, fan-shaped masses of foliage and twigs. Mistletoe shoots can usually be found on twigs in these brooms. The shoots of this species are relatively large, about 4 to 5.5 inches long, and yellow to yellow-green in color. They produce a white to greenish-white fruit in late summer to fall that forcibly expels a single seed. Lightly infected trees are not significantly affected by the dwarf mistletoe. Moderately to heavily infected trees, however, undergo reduced height and diameter growth and have poor vigor. These trees become increasingly susceptible to successful attack by cambium feeding insects, especially if other stress agents such as

drought are active. The most common insects involved in this mortality include Jeffrey pine beetle (*Dendroctonus jeffreyi*), California flatheaded borer (*Melanophila californica*), and California fivespined ips (*Ips paraconfusus*).

Western white pine dwarf mistletoe was previously considered to be sugar pine dwarf mistletoe, but has recently been recognized as a distinct species (Hawksworth and others 1992). It is endemic to the Siskiyou and Klamath mountains of northwestern California and southwestern Oregon. It is rarely found on sugar pine, and only when the two conifers are closely associated. It has a similar effect on its host as western dwarf mistletoe, including the development of witches' brooms. Mistletoe shoots are slightly smaller, 2 to 4 inches long, and brown to red in color. Trees that develop moderate to heavy infections may be successfully attacked by mountain pine beetle (*D. ponderosae*), California flatheaded borer, California fivespined ips, and emarginate ips (*I. emarginatus*).

The third species of dwarf mistletoe, knobcone pine dwarf mistletoe, was only recently described (Hawksworth and others 1992). It had previously been identified as western dwarf mistletoe. It is endemic to the Siskiyou and Klamath mountains of northwestern California and southwestern Oregon. It rarely infects ponderosa, Jeffrey, and lodgepole pines when they are growing in close association. The mistletoe shoots are 2.5 to 4 inches long and brown in color. This mistletoe differs from the other two in not producing distinctive witches' brooms. Infections are recognizable by the presence of shoots and branch swellings at the point of infection. It is suspected that moderate to heavy levels of infection result in reduced rates of growth. These trees become susceptible to successful attack by the Monterey pine ips (*I. mexicanus*), California flatheaded borer, and California fivespined ips.

Numerous other native insects and pathogens occur on all conifers found on these sites. The three common root diseases found in California, annosum root disease (caused by Heterobasidion annosum), armillaria root disease (caused by *Armillaria ostoyae*), and black stain root disease (*Leptographium wageneri* var. *pseudotsugae*) can occasionally be found, but are infrequent and do not appear to be significant factors on these sites. Other pathogens and insects generally attack individual branches or stems and usually cause little significant widespread injury. They normally are also limited in the variety of species they attack.

Two nonnative pathogens occur on conifers on serpentine sites in northwestern California: Port Orford cedar root disease (*Phytophthora lateralis*) and white pine blister rust (*Cronartium ribicola*). Port Orford cedar root disease is currently limited to the Smith River watershed except for occasional infections found in ornamental plantings along the coast. It is believed it was introduced into California in the late 1950s or 1960s (Kliejunas and Adams 1981; Zobel, Roth, and Hawk 1985). White pine blister rust attacks white pines and gooseberry's (*Ribes* spp.) and is found throughout the area covered by this guide. It was introduced into the area in the 1930s with subsequent spread southward.

Port Orford cedar root disease affects principally Port Orford cedar, but Pacific yew have been found infected by the fungus when they are in close association with the principal host (DeNitto and Kliejunas 1991; Murray 1995). Infection of Port Orford cedar is fatal in the vast majority of cases. Most living trees in infested pockets have likely escaped infection, but resistance to the pathogen is being explored. The presence of the disease is related to human activities and the presence of standing or flowing water. The fungus is transported either in water or soil and is not airborne, please see the resource protection alert below. It is likely that there is a relationship between plant association and occurrence of the disease, a relationship that is currently being investigated. Clearly, plant

association influences subsequent spread of the fungus within a drainage because of the position of certain plant associations along streams and the density of Port Orford cedar and the likelihood of root contacts. Topography plays a role in the amount of Port Orford cedar lost from a drainage since uphill spread of the fungus without human assistance is limited (Hansen and others 1993). Two characteristics help to identify the presence of Port Orford cedar root disease. Areas infested by the fungus normally have trees in various stages of decline and mortality as the fungus spreads through the area. Individual trees that have not completely faded have a recognizable cinnamon-brown discoloration of the phloem that comes up the stem from the root system. Infestations of a drainage can have significant ecological effects because of the loss of the vast majority of Port Orford cedar along the rivers and streams.

The principal species affected by white pine blister rust on serpentine areas are western white pine and sugar pine. Gooseberry's are also infected, but the effect is minimal. Conifer hosts can be killed directly by the fungus or can result in successful attack by mountain pine beetle and California flatheaded borer. Regeneration size pines are more significantly and rapidly affected than larger trees because of the shorter time required for the fungus to grow around and girdle the main stem. Occurrence of this disease is dependent on the presence of both the pine host and the gooseberry host in the area and proper environmental conditions. That is part of the reason why this disease is more common and damaging in some sites than others. It is becoming apparent that some areas are losing regeneration that could eventually replace existing overstory trees and alter the successional pathway. In addition, larger western white pines are being increasingly affected by blister rust through trunk and branch infections in the upper crowns, which leads to eventual mortality. Observations on the Siskiyou National Forest indicate the loss of western white pine on selected sites due to the disease. Some natural resistance has been identified in sugar pine in California (Kinloch and others 1970) and in western white pine elsewhere (Bingham 1983). These mechanisms are being developed and rust resistant planting stock are available for some areas. Other management strategies, including thinning, pruning and gooseberry management, are available and may be effective in some area.

Resource Protection Alert

If you have been travelling the backroads of southwest Oregon and northwest California during wet periods, please be aware that you could be transporting the spores of a disease which is fatal to one of the most ecologically and commercially significant conifers, Port Orford cedar (POC). The disease spreads from infected to uninfected areas by the transport of its spores trapped in the mud on the bottom of vehicles and on equipment. In northwest California, POC commonly grows along stream and river corridors. Once introduced into a drainage, the disease can spread rapidly downstream and kill entire stands of POC.

What Can You Do? Before venturing out on the backroads, contact your local District Ranger Office to determine if your travel route passes through infected areas. On the Six Rivers, POC occurs on the Smith River National Recreation Area (SRNRA), and on the Orleans and Lower Trinity Ranger Districts. To date, the disease is only present in specific areas within the SRNRA. If there is any doubt as to whether you have been in an infected area, please make it your responsibility to pressure wash the underside (including the fender walls, bumpers etc.) of your vehicle at the nearest car wash before and after driving backroads in wet weather. Thank you for playing a role in the effort to conserve Port Orford cedar.

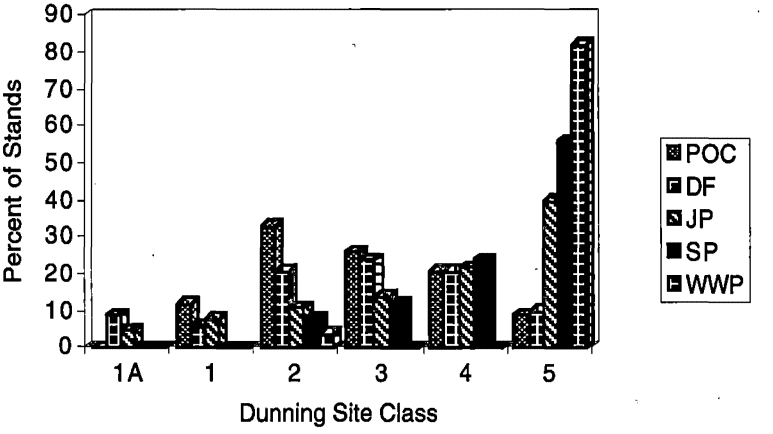


Figure 8. Percent of stands by Dunning site class and vegetation series.

Vegetation Productivity and Stand Structure

Vegetation productivity on serpentine soils is reflective of slope position. Lower one-third slope positions are more productive than upper one-third due to both colluvial (soil moved by gravity) and alluvial (soil moved by water) soil movement. Lower one-third slope positions can be thought of as areas of maximum soil accumulation, while their upper one-third slope counterparts can be thought of as areas of maximum soil loss. This is particularly important in upper slope positions where soil loss leads to shallow soils and uncovers serpentine soil surfaces that have low soil development. These shallow, less developed soils may have lower calcium/magnesium ratios than deeper more developed serpentine soils (Alexander and others 1989).

Vegetation productivity in forest stands is described below by site class, site index, softwood cubic volume, softwood basal area, stand density index, and structural attributes. They are displayed here to compare and contrast the potentials of these harsh sites to produce vegetation and stand structure. Site class is displayed first, it is determined by the relationship of tree height to age and can also be expressed as site index. Dunning site class (Dunning 1942) is

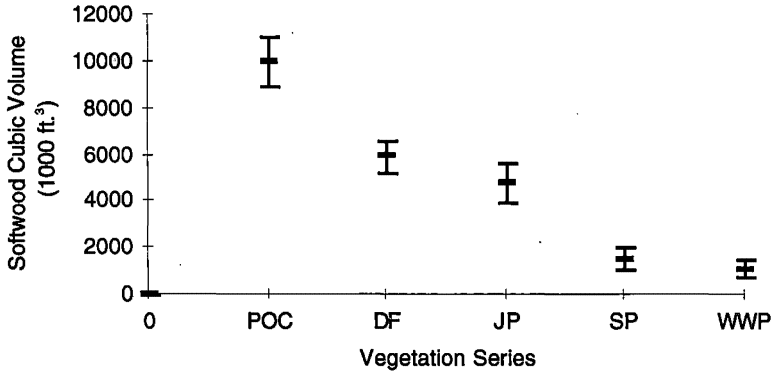


Figure 9. Mean standing softwood cubic volume by vegetation series with 95% confidence intervals around the means.

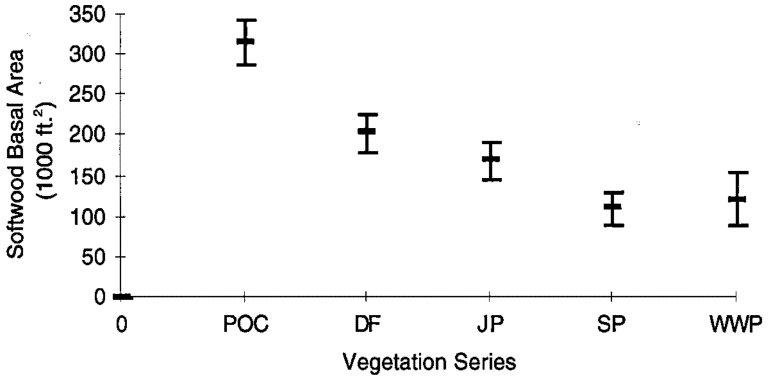


Figure 10. Mean softwood basal area by vegetation series with 95%confi dence intervals around the means.

used in figure 8 to compare vegetation series productivity. It ranges from site class 1A through 5. These site classes correspond to predicted tree heights at the base age of 300 years. For example a site class 1A stand would be expected to produce trees of 200 feet tall at 300 years stand age, while a site class 5 stand would produce trees 75 feet tall at 300 years of age. Standard error bars are used to compare softwood cubic volume, softwood basal area, and stand density index. These bars display the mean value as the center line and plus and minus two standard errors of the mean using the top and bottom lines. This display is known as a 95% confidence interval around the mean. It says that you have a 95% probability of encountering the mean for the particular attribute measured between the top and bottom lines. The first standard error bar comparison uses softwood cubic volume as its attribute, figure 9. Softwood cubic volume is described in cubic feet/acre and is calculated by measuring the height, diameter, and taper of each tree, calculating its internal volume, and summing the volumes to come up with a per acre sum. An example interpretation of the graph using Port Orford cedar as an example is that the sample mean cubic volume for the

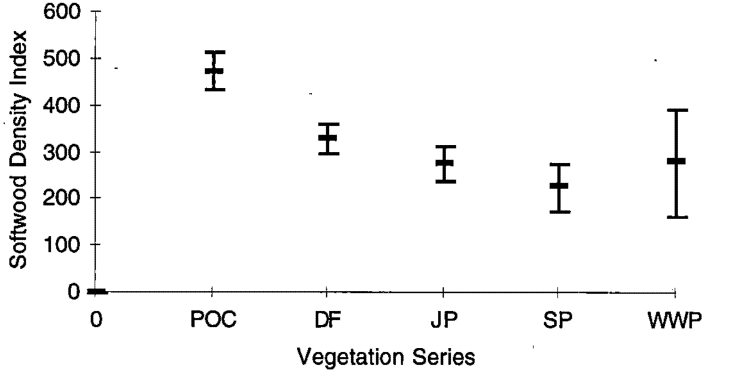


Figure 11. Mean stand density index by vegetation series with 95% confidence intervals around the means.

series is approximately 10,000 cubic feet/acre and that the actual mean lies somewhere between 8900 and 11,100 cubic feet/acre.

Softwood basal area is compared next, figure 10. It is described in square feet/acre and calculated by summing the diameter of each tree measured at breast height (4.5' above the ground). Next, stand density index (Reineke 1933) is displayed figure 11. It is a method for comparing the density of trees in stands of dissimilar tree size. Stand density index describes density by relating all trees to 10" in diameter. Lastly, stand structure attributes are described Table 2. These attributes include mean age, diameter, and height for the top (T1), second (T2), and third (T3) layers, as well as the mean number of trees/acre by size class.

Productivity is described here by vegetation series. The Port Orford Cedar series clearly had the highest productivity of all series. It had the highest frequency of high site stands with a range of site classes from 1 to 4 and a modal site class of 2. It also had the highest mean softwood cubic volume (10,017 $ft.^3$), softwood basal area (315 $ft.^2$), and stand density index (474) (figs.9-11). In addition, the Port Orford Cedar series had the tallest overall tree height (T1=124', T2=99', T3=71'), the largest mean diameters (T1=37", T2=28", T3=19"), and the highest number of large trees/acre (48 tpa > 25" and 22 tpa > 30"), and greatest mean stand age (342 years) (Table 2). This high productivity is a result of the streamside and lower one-third slope positions where site conditions such as soil depth and available water holding capacity are best suited for conifer growth.

The Douglas-fir series is second in overall productivity, but significantly lower than the Port Orford Cedar series (figs. 8-11). Site class ranged from 1A to 5, with a mode of 3. Which site class dominates is dependent on plant association. Softwood cubic volume (5902 $ft.^3$), softwood basal area (203 $ft.^2$), and stand density index (329) were also second highest in the Douglas-fir series. Stand structure attributes also follow this same trend with tree height (T1=125', T2=92', T3=58'), diameter (T1=34", T2=25", T3=15"), large diameter trees/acre (26 tpa > 25" and 10 tpa > 30"), and stand age (244 years) second highest of all series. Slope position ranged from lower to upper one-third slopes and helps explain the variation in productivity due to differences in soil depth and available soil water holding capacity.

The Jeffrey pine series was next in productivity, but showed no significant differences in softwood cubic volume, softwood basal area, and stand density index with the Douglas-fir series. It was found to be significantly higher in softwood cubic volume and softwood basal area than the western white pine and sugar pine series. Site class in the Jeffrey pine series ranged from 2 to 5 with a mode of 5. Stand structure attributes were less than the Douglas-fir series with significant differences found in T1 (90') and T2 (68') layer heights and T1 (29") and T2 (20") diameters, as well as the number of large trees/acre (17 tpa > 25" and 7 tpa > 30"). Variation in productivity in the Jeffrey pine series was due to the ridgetop and upper one-third slope positions where soil depth and available water holding capacity were at their lowest.

The sugar pine series was next in productivity, together with the western white pine series they had significantly lower softwood cubic volumes (1527 ft.3 and 1090 $ft.^3$) and softwood basal area (111 $ft.^2$ and 122 $ft.^2$) than all other series. Site class ranged from 3 to 5 in the sugar pine series with a mode of 5. Stand structure was significantly lower than all other series with the exception of the western white pine series. The sugar pine series was significantly greater than the western white pine series in T1 age (189 years to 125 years), diameter (13" to 9"), and height (75' to 55'), as well as T2 diameter (19" to 11") and height (68' to 46'),

Table 2. Mean stand structure attribute comparison by layer and vegetation series.

	POC	DF	JP	WWP	SP
T1 (TOP LAYER)					
Age (years)	342	244	221	125	189
Std. Error	14	10	8	9	13
DBH (inches)	37	34	29	14	24
Std. Error3	2	3	3	4	
Height (feet)	124	125	90	55	75
Std. Error	3	2	3	3	4
T2 (second layer)					
Age (years)	266	207	165	104	122
Std. Error	15	12	9	10	12
DBH (inches)	28	25	20	11	19
Std. Error	1	1	1	1	2
Height (feet)	99	92	68	46	68
Std. Error	3	3	3	3	2
T3 (third layer)					
Age (years)	182	161	145	81	66
Std. Error	19	21	17	18	11
DBH (inches)	19	15	14	10	18
Std. Error	2	2	1	2	9
Height (feet)	71	58	48	42	44
Std. Error	5	5	3	7	1

and number of large trees/acre (11 tpa > 25" to 3 tpa > 25"). Low productivity in this series is due to ridgetop and upper one-third slope positions where soil depth and available water holding capacity are low.

The western white pine series was the lowest in productivity of all series. Site class ranged from 4 to 5, with a mode of 5. Stand structure attributes were also the lowest of all series and differed significantly in T1 age, diameter, and height. An example of these gross differences is found in T1 mean height of 55 feet in the western white pine series compared to 124 feet in the Port Orford Cedar series. In addition, very few trees greater than 25" diameter (3 tpa) were found during sampling of this series. The extremely low productivity in the western white pine series is due to its cool, ridgetop and upper one-third slope positions, high surface and soil rock fragments, which contribute to low available water holding capacity.

RARE PLANTS OF THE SERPENTINE ENVIRONMENT

This guide features the serpentine environment--its vegetation, geophysical properties, diversity and distribution across the landscape. A discussion of the serpentine environment is remiss without a discussion of its distinctive flora, rich in rare and endemic plant species.

Plant species are classified as "**rare**" due to a combination of factors related to limited distribution, the limited number of populations in existence, and small population size. Fiedler (1994) describes three patterns of rarity; a. broadly distributed but never abundant (ie. California lady's slipper, *Cypripedium californicum*), b. narrowly distributed and abundant where found (ie. western bog violet, *Viola primulifolia* ssp. *occidentalis*), and c. narrowly distributed and not abundant (ie. two-flowered pea, *Lathyrus biflorus*; Lassics lupine, *Lupinus constancei*). This array of patterns suggests diverse pathways to rarity and likely, diverse ecological, and evolutionary consequences of such a condition (Rabinowitz 1981).

Rarity in plants can be a function of particular life history requirements, limited extent of habitat (either due to natural or anthropogenic factors), temporal factors (geologically "new" habitats versus relict habitats), or habitat specialization (ie. edaphic endemics) (Fielder 1994, Pavlik and Skinner 1994, Kruckeberg 1991). In the case of serpentine environments, habitat specialization coupled with the insular nature of serpentine sites, provides a strong explanation for why we find such a high concentration of rare plant species in these environments.

Serpentine environments are highly toxic to most plant species. Those taxa which do occupy serpentine sites harbor myriad mechanisms for adjusting to such a seemingly harsh environment. For example, low calcium, high magnesium and high heavy metal concentrations are physiologically managed by the plants through their ability to "hyper-accumulate" high concentrations of heavy metals, selectively absorb nitrogen and phosphorous, or restrict uptake of magnesium through exclusion in the nonliving cell wall of the roots (Kruckeberg 1984). Morphologically, plants growing in dry and exposed serpentine habitats often exhibit water-saving or light reflectance adaptations such as glaucous, pubescent or purple-colored foliage, a basal rosette leaf arrangement, and tufted or decumbent habit (Kruckeberg 1992).

Operating at the community level, the coexistence of species depends upon the differential way each plant copes with such a limiting environment. Certain plants may be better at selective uptake of nitrogen, while others may operate sufficiently as hyper-accumulators of nickel. The relationship of plants within a community, in terms of composition, density and physiognomy, depends upon the "summed response" of several factors in simultaneous operation. Hans Jenny (1980) termed this response the "serpentine syndrome" whereby he recognized the interplay of biotic, physical and chemical factors in defining the composition and pattern of vegetation. Pattern and causes of rarity are likewise a summed response to the interplay of these factors.

The creation of this guide, including the two parts--vegetation classification and rare species--intends to emphasize the coarse and fine-filter approach to land management. Rare species and the habitats in which they exist represent the fine filter through which we must sieve our decisions. As a public land agency, we are obligated to maintain viable populations of species, and to manage for sustainable ecosystems and biodiversity. Species are biological threads, if you will, that create the living fabric of our landscape. When species become rare, they can signal a trend towards loss, a threadbare fabric. Loss brought about by human

actions should alarm us for species are links in ecosystem functioning--reservoirs, cleansers, cyclers; medicines for human maladies as evidenced by a history of use by indigenous peoples; and visual variety in the landscape. When a species becomes rare, we have to wonder about the role of our management decisions in causing or exacerbating a trend toward rarity. We must scrutinize past management decisions, evaluate current practices and act accordingly to better secure the existence of a species into the future.

Beyond attention paid to land management decisions, conservation of species warrants the study of conditions defining the plant community in which species are found. Admittedly, we do not fully understand the autecological requirements of many rare species nor can we state without a doubt "why" certain species exist where they do; however, in documenting relationships between rare species occurrences and plant associations discussed in this guide, we gain access to information about the environmental features of the community in which the rare species occurs. If rare species commonly occur within certain plant associations, we can begin to focus on those features that best define the habitat of a given rare species.

Within the study area, there are 18 **sensitive** and rare plant species within the Jeffrey Pine/Idaho Fescue (PIJE/FEID) plant association. Of the total, 5 species are members of the Forest Sensitive Plant list; specifically, McDonald's rock cress (*Arabis macdonaldiana*), Oregon bleeding heart (*Dicentra formosa* ssp. *oregana*), Waldo buckwheat (*Eriogonum pendulum*), pale yellow stonecrop (*Sedum laxum* ssp. *flavidum*), and yellow-tubered toothwort (*Cardamine nuttallii* var. *gemmata*) (recommended for addition). Most of these species also occur within extreme habitats, referred to as Siskiyou Mat/Idaho Fescue (CEPU/FEID)//Serpentine Barrens which are distinguished by their high surface rock content and sparse vegetation cover. Features common to the PIJE/FEID plant association (Jimerson 1993) and CEPU/FEID//Serpentine Barren habitat are ridge-top position, sites of bare serpentine soil, low overstory cover, low shrub cover, and high radiation index. Studies in the PIJE/FEID plant association indicate that the underlying cause for the low shrub and overstory cover may be due to the low Ca/Mg ratio (McGee-Houghton 1995, Dubendorfer 1987) and high rock fragment volume (Jimerson 1993) of the soil surface. Soil chemistry studies in CEPU/FEID// Serpentine Barrens could reveal similar results.

In general, the diversity and cover of rare species appears to decline in serpentine environments where tree and shrub cover values are high. McDonald's rock cress appears to be particularly sensitive to increased cover values. Within the PIJE/FEID association, McDonald's rock cress occurs at lower densities than in the CEPU/FEID//Serpentine Barrens. The preference of McDonald's rock cress for the barrens habitat could be due to its inability to compete with Idaho Fescue (which dominates the ground cover of the PIJE/FEID association) for scarce resources. Even within the PIJE/FEID association, McDonald's rock cress often occupies exposed outcrops or bare micro-sites. In general, those plant associations in serpentine settings which are defined by more productive soils, lower slope position or north-facing aspects will support a higher vegetation cover in most of the layers (overstory, shrub and forb) to the exclusion of rare species.

In addition to defining habitat characteristics, considering rare species habitat in the context of plant associations helps guide our survey efforts. The relationship existing between rare species and certain plant associations enables stratification of surveys at the plant association level for certain species. It is recognized that some rare plants may occupy very specific habitats not discernible at the plant association level. To date CEPU/FEID//Serpentine Barren habitats and California

pitcher plant bogs have been identified as two such habitats occurring on Six Rivers National Forest. Even among these habitats, the distribution of rare plants can be highly localized. An example is the western bog violet which exhibits irregularity in its distribution within and among bogs. The lack of constancy for the western bog violet across the bog habitats points out that segregating special habitats is helpful as a first-level stratification; however, intensive surveys are needed to verify presence or absence and to better estimate the extent of its habitat. Estimating the extent of potential habitat from airphotos or satellite imagery should take into account the irregular distribution of certain species.

Identifying key habitat characteristics is a fundamental step in rare plant conservation; however, we must learn more about the underlying processes supporting these characteristics if we are to manage for the sustainability of rare plants. In coping with a highly restrictive environments, the availability, transport, uptake and cycling of specific nutrients and minerals are of paramount importance (Walker 1954, Kruckeberg 1992). Given the relatively infertile soils, mycorrhizal relationships are considered important to plant survival in serpentine environments. Research by Hopkins (1986) indicated that 98% of the herbaceous plants in the serpentine grassland communities of the Santa Cruz Mountains of central California were mycorrhizal. According to St. John (1986), ectomycorrhizae are often associated with members of the Ericaceae family, a well-represented group in the serpentine flora.

Fire is also a process operating in serpentine settings, evidenced by the presence of such fire-related species as knobcone pine, lodgepole pine and numerous species of manzanita. Coupled with plant-soil interactions, fire has been defined as one of the factors responsible for the vegetation mosaic of the Jeffrey pine woodland and shrubland of Pine Flat Mountain in Del Norte County (Duebendorfer 1987). Under certain conditions, fire increases the availability of essential nutrients, raises pH and activates soil microorganisms (Woodmansee and Wallach 1981). Furthermore, certain rare species may be well served by fire's role in reducing competition of woody species, stimulating the seed bank, and increasing nutrient availability (McCarten and Rodgers 1991).

Restoring processes which maintain the habitats of rare species must be conservatively implemented and studied closely. The response of individual species to fire is as variable as the components of fire (ie. intensity, season, frequency). Introducing fire without considering the life histories of individual species and the variability inherent in the sites upon which they grow, could yield deleterious results for rare species (Parker 1990). Parker (1990) also suggests that species growing on serpentine sites may suffer greater mortality and poorer recruitment after a fire than the same species on adjacent sandstone-derived soils. Conversely, inactivity is also cautioned for fire suppression could bring about the demise of plant populations which depend on fire for recruitment, relief from competition or release of essential nutrients. Relative to competition of woody species, observations within the PIJE/FEID association indicate that historic fire suppression practices have allowed for the encroachment and spread of huckleberry oak.

Serpentine environments are globally limited. By virtue of association, plant species with specific habitat preferences within these environments are often considered rare. Nevertheless, land management decisions have and can accelerate trends towards the endangerment of our rarest species. The greatest threat to rare species is surface mining. The concentration of heavy metals in serpentine rock, namely nickel, copper and chromium, has attracted miners to this country since the late 1800s. The scars of a mining history are evident today

with piles of mine tailings, mining roads concentrating water from upslope, and eroding mined sites. Disturbed areas also become sites for trash dumps and backdrops for target shooting.

Nevertheless, the historic perception of serpentine environments has shifted as a growing number of forest users begin to recognize their high recreational value--the open and distant vistas, the unusual beauty of the gnarled Jeffrey pine trees, the striking contrast of wildflower color against the grey-green or red rock. But encouraging the public into these areas also carries certain risks. Access needs to be well planned to discourage resource damage. Existing roads accessing open areas of flat topography can encourage cross-country travel by hikers, mountain bikers and off-highway vehicle (OHV) enthusiasts. Roads can also act as interceptors of surface and subsurface water that would normally flow downslope. The unnatural concentration of water can create gullies in these highly erodible soils (Kruckeberg 1992) and cause subsequent road failures. Roads which divert water also subject rare plants in need of wetland habitats to drying conditions. A related concern surrounding access in serpentine areas is the spread of Port Orford cedar root disease. Spores of the disease infect the live root tips of the cedar and can persist in the environment for months and possibly years (Zobel and others 1985). The disease is lethal and there is currently no form of treatment. Port Orford cedar is commonly found in association with many rare species. The L.E. Horton Research Natural Area ecological survey (Keeler-Wolf 1986) and results of rare plant surveys in bogs commonly surrounded by Port Orford cedar communities (most recently, 1995 field surveys) revealed Siskiyou indian paintbrush (*Castilleja miniata* ssp. *elata*), California pitcher plant (*Darlingtonia californica*), Waldo gentian (*Gentiana setigera*), great burnet (*Sanguisorba officianalis*) and western bog violet growing in association with one another. Loss of Port Orford cedar, as the primary associating conifer, could lead to the cumulative loss of the rare plant species associated with wetland communities.

The distinctiveness of serpentine environments and the high concentration of rare flora warrant special management considerations. Conservation of the serpentine environments with such a high concentration of rare plants can best be ensured by limiting activities on particularly sensitive/vulnerable sites; planning the type, level and location of access; and educating forest users and land managers about their values. Certain activities such as intensive recreation development and timber management should be carefully reviewed in these areas. The potential for mining is an on-going threat. Withdrawal from mining should be considered but due to the many levels of approval, the time involved and other factors, interim mitigations are needed. In the interim, mitigations for mining should emphasize restoration (as distinguished from revegetation or reclamation). Given the difficulty in restoring degraded serpentine sites, preliminary studies and monitoring are needed to determine the best plant material, propagule, cultural and site preparation techniques. For example, after mechanical disturbance, such as that related to mining and road construction, mycorrhizal fungi (essential for the establishment and growth of certain plants) are often absent due to the loss of a host plant or limited dispersal capabilities of the fungal propagules; therefore, mycorrhizal inoculation is necessary on most disturbed sites (St. John 1986). Before attempting restoration of mined sites, studies are needed to determine the significance of mycorrhizal relationships in serpentine communities.

Land allocations should respect the uniqueness of these serpentine areas and conserve their natural features. On the Six Rivers National Forest, much of the extensive serpentine areas are within Special Interest Areas, specifically, Botanical

Areas. The primary goal of the Botanical Area Program is to manage for the full complement of species and plant communities as well as the natural processes which maintain plant habitats. Establishment of Botanical Areas contributes to the Forest Service direction to manage for the conservation of biological diversity. Of the 6 Botanical Areas on the Six Rivers National Forest, 5 are noted for their serpentine environment (Table 4). The Klamath, Shasta-Trinity, and Siskiyou National Forests have also established Botanical Areas which feature a variety of serpentine habitats and select species (Appendix IX).

Significant opportunity exists to enhance the public's enjoyment of these areas through the development of trails, interpretive signing, brochures and vista turnouts. Much can be realized in the realm of education and interpretation, as well as rare plant research, habitat restoration and enhancement through cooperative efforts with entities interested in the conservation of rare plants. Potential partners include government agencies, professional societies, universities, conservation organizations, businesses and garden clubs.

Another land allocation which affords protection of serpentine environments is the Research Natural Area (RNA) designation. RNAs are intended to represent target elements--vegetative types or habitats capturing the spectrum of diversity within the Region (Keeler-Wolf 1990). RNAs are intended for non-manipulative research and study purposes, and in some cases, offer benchmarks against which we can measure the effects of our management. On the Six Rivers, the L.E. Horton RNA (1,305 acres) features a California pitcher plant bog community and other serpentine communities which contain a high concentration of rare and endemic plant species. The Shasta-Trinity and Siskiyou National Forests also support RNAs which contain serpentine habitats.

Conservation of rare species benefits from a holistic approach--a viewshed in which we observe, study and monitor the dynamics of reproduction, population shifts, dispersal and other life history mechanisms of individual species. This perspective also considers species in their "context"--their habitat and community. A broad-based constituency, ranging from land managers and academia to recreationists, is critical to the protection of serpentine environments and the rare plants found therein. In its diversity and peculiarities, the enigmatic world of serpentines invites inquiry, exploration and further study. We hope that this guide will stimulate an interest in serpentine environments and lead to their long-term stewardship.

Table 4. Botanical Areas of the Six Rivers National Forest featuring serpentine habitats.

Name:	Acres:	Features:
Six Rivers National Forest		
North Fork Smith River	31,330	High concentrations of rare and endemic plant species occurring within various botanically diverse plant communities.
Broken Rib Mountain	7,140	Ecological diverse area with Jeffrey pine, Douglas-fir and white fir dominated stands, exposed areas of bedrock throughout.
Myrtle Creek	1,950	Transition zone between redwood and Douglas-fir forests, with knobcone pine, Port Orford cedar, and California Pitcher Plant seep communities.
Horse Mountain	1,080	Open Jeffrey pine and western white pine, and the southern extension of Port Orford cedar.
The Lassics	4,520	High elevation, open Jeffrey pine woodland, montane chaparral, serpentine barrens, wetlands and endemic species.

USING THIS GUIDE

The guidebook is based on field sampling throughout the range of serpentine soils in Northwest California as depicted in figure 1. It contains descriptions of plant associations included in the Jeffrey pine, Douglas-fir, Port Orford cedar, sugar pine and western white pine series. It includes keys to and descriptions of each series and plant association including vegetation composition, environment, soils, productivity, stand structure, and management implications.

Each plant association has an abbreviated name described below and a regional number (Eco Class Code) for identification purposes. The regional identification number is used to correlate the plant association with any type of survey work. Examples include ecological unit inventory, wildlife habitat relationships, forest inventory analysis, soil survey, vegetation mapping, and old-growth inventory.

Plant association nomenclature

Species were assigned to structural categories, such as tree, shrub, herb, or grass, and given an abbreviated code according to the "Electronic Data Processing Codes For California Wildland Plants" (Reed and others 1963) or the Plants Database (USDA Soil Cons.Serv. 1994). These EDP codes are used throughout the ecological classification program in California to standardize the identification of plant species and the naming of plant associations. The codes use the first two letters of the genus and first two letters of the specific epithet (species) and a numeric code if necessary to distinguish species. Using Jeffrey pine as an example, *Pinus jeffreyi* would be represented as PIJE.

The plant association name is broken down into two parts, first the biotic and second the abiotic. The biotic segment is subdivided by strata, while the abiotic is separated by a double "//". Within the biotic portion of the name a "/" is used to represent a stratum change, while a "-" represents species in the same stratum. Examples of different plant association names include; PIJE-CADE3/QUVA/XETE, PSME/QUVA and CEPU1/FEID//Serpentine Barrens. In the first case, PIJE-CADE3/QUVA/XETE, three strata are present (tree-tree/shrub/herb). In the second case PSME/QUVA, includes only two strata (tree/shrub). The third case, CEPU1/FEID//Serpentine Barrens, involves two strata and a special feature (shrub/grass//Serpentine Barren). The abiotic portion of the name may be added to describe some special feature of the plant association, such as the previous example where the community is found on serpentine barrens.

The order of species in the plant association name identifies the vegetation series and subseries. The first name listed identifies the series, while the second name identifies the subseries. The series is the naturally reproducing species that will dominate a site as the end product of succession. The sub-series is the indicator of the position of this ecological type along the environmental gradient within the series. Using the plant associations described above the PIJE-CADE3/QUVA/XETE type is included within the Jeffrey pine series. Within this type Jeffrey pine is the naturally reproducing species that dominates late seral stands. The sub-series modifier, incense cedar, indicates the dry end of the Jeffrey pine series environment gradient. The PSME-UMCA/RHDI plant association is included in the Douglas-fir series. The subseries modifier California bay indicates the mesic end of the moisture gradient.

Plant association descriptions

A description of each plant association is provided which includes descriptions of vegetation, environment, soils, productivity, stand structure, and management implications as described in detail below. Drawings of the indicator species are included as well as a photograph of each plant association. Summary tables are

also provided in the appendices that allow for comparison of plant associations by the variable categories described below. Terms used in this document are highlighted and defined in the glossary.

Distribution/Environment

The distribution is defined by National Forest Ranger District. The physical environment is defined by distance to the Pacific Ocean, elevation, aspect, percent slope, slope position, surface rock percent, and radiation index (ratio of total annual radiation on a given aspect and slope to total annual radiation received on a flat surface for a given latitude) (Frank and Lee 1966). Comparisons of each plant association by environment variables are contained in Appendix II.

Soil Summary

Soils are described by depth to a maximum depth of 40 inches or to bedrock, AWC calculated to 20 inches. A horizon thickness, A horizon coarse fragment percent, A horizon texture, and parent material. Soils are classified to Order, Subgroup or family. Each plant association is compared by soil variables in Appendix III.

Vegetation variables

Vegetation is first described by total percent cover for each layer including overstory and understory trees, shrubs, forbs and grasses. Species with greater than 20% constancy are listed for each plant association. All plants were identified to species where possible. Species nomenclature follows Munz (1973) and Hickman (1993) common names used follow the Plants Database (USDA Soil Cons. Serv. 1994). A complete list of species encountered during this study are included in Appendix I, a vegetation summary by plant association is included in Appendix V.

Disturbance and Age Class Distribution

Disturbance is described by the primary agent and explained through an age class distribution analysis.

Stand structure variables

Stand structure is described by mean values for stand age, trees/acre by diameter class, layers, height, conifer and hardwood cubic volume and basal area, Dunning site class (base age 300 years), and stand density index. Stand structure is compared by plant association in Appendix IV.

Successional Trends

Successional trends are described through an analysis of disturbance agents, both natural and human.

Rare Plant Relationships

Rare plants occurring in each plant association are listed.

Management implications

Management implications are provided for each plant association to supply the reader with predictive information on each plant associations response to treatment and any special problems that may be encountered.

Closely Related Types

Closely related types are listed and significant differences between types are described.

USING THE VEGETATION KEYS

Keys to both vegetation series and plant associations on serpentine parent materials are provided. The series key should be used first. It uses the dominance of key species in the overstory and regeneration layer to determine the potential natural vegetation series. The plant association keys use the presence of or percent cover of the indicator species to key to plant associations.

Before attempting to use the key, you should walk around the stand and familiarize yourself with the vegetation. The key and vegetation descriptions are constructed from data collected in late seral stage stands (PNV). Therefore, if you are trying to use them in younger or disturbed stands you should be aware that the percent species cover may not apply. For example, younger stands maybe dominated by lodgepole or knobcone pine. They need to be carefully examined for the presence of the PNV regenerating species, western white pine, sugar pine or Douglas-fir in order to key to the correct plant association. The indicator species should be present in all of these stands.

The key is structured as a choice between two statements. To use the key first read both choices carefully, then choose the one that applies to the stand. This process is repeated until you end up at a plant association name. From here proceed to the description of the selected plant association and check the description (environment and vegetation) to make sure that you have keyed to the correct vegetation type. If the description does not fit or you become lost in the key, return to the step you felt most secure at and try the key again.

Characteristic cover is used in this document rather than average cover. Characteristic cover is defined as the percent cover one could expect to find in a plant association if the species were present in this type. It is the average cover of stands containing the species. For example plant association X includes 10 plot samples, on 5 of these plots species Y had 10% cover. Its characteristic cover would be 10%. Characteristic cover is displayed along with constancy. Constancy is the percent of times a species was found to occur in a plant association among the plots sampled. Using the same example from above, species Y would have a constancy of 50%, that is it occurred in 50% of the plots sampled.

Serpentine Field Guide Key

1 a. Tree cover < 10% 2

2 a. Bare serpentine soil dominates the site,micro-positions ridgetops or noses of ridges ..... Serpentine Barrens series

2 b. Perennial wet soils, California pitcher plant present ..... California Pitcher Plant//Bogs

1 b. Tree cover > 10% 3

3 a. Jeffrey pine dominant tree and reproducing successfully ..... Jeffrey Pine series

3 b. Jeffrey pine absent or not as above 4

4 a. Douglas-fir dominant tree and reproducing successfully ..... Douglas-fir series

4 b. Douglas-fir absent or not as above 5

5 a. Sugar pine dominant tree species and reproducing successfully. ..... Sugar Pine series

5 b. Sugar pine absent or not as above 6

6 a. Western white pine dominant tree species and reproducing ... successfully ..... Western White Pine series

6 b. Western white pine absent or not as above 7

7 a. Port Orford cedar dominant tree species and reproducing .. successfully ..... Port Orford Cedar series

7 b. Port Orford cedar absent or not as above 8

8 a. Lodgepole pine dominant tree species 9

9 a. Western white pine reproducing successfully ..... Western White Pine series

9 b. Not as above 10

10 a. Sugar Pine reproducing successfully ..... Sugar Pine series

10 b. Not as above 11

8 b. Lodgepole pine absent or not as above 11

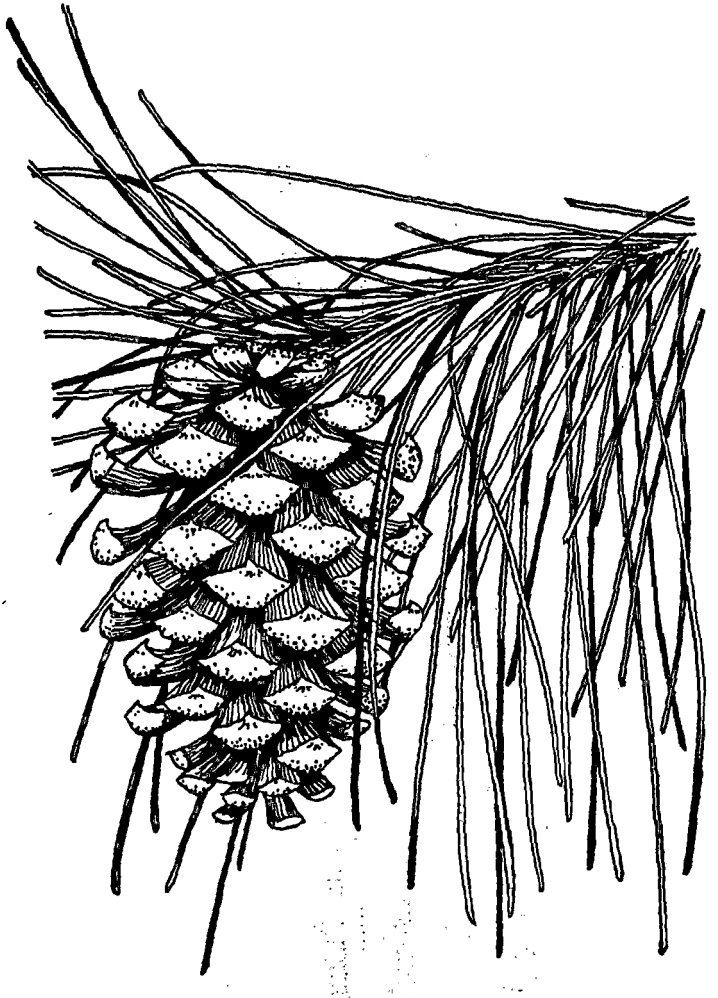
11 a. Knobcone pine dominant tree species 12

12 a. Douglas-fir reproducing successfully ..... Douglas-fir series

12 b. Jeffrey pine reproducing successfully ..... Jeffrey Pine series

11 b. Not as above. ..... Return to Step 1.

Jeffrey Pine Series



INTRODUCTION TO THE JEFFREY PINE SERIES

The Jeffrey pine series was described using 123 ecology plots distributed from Del Norte County near the Oregon border to north of Clear Lake in Mendocino County and just east of the Pacific Ocean to just east of Happy Camp in Siskiyou County. The highest frequency of plots were sampled in Del Norte County, where the greatest extent of serpentine soils were found (fig.1). Second in number of plots was the Orleans Ranger District in Humboldt County, followed by the Lower Trinity Ranger District in Humboldt County, Mad River Ranger District in Humboldt and Trinity Counties, Happy Camp, Salmon River and Ukonom Ranger Districts in Siskiyou County, and the Corning and Upper Lake Ranger Districts in Mendocino County.

Analysis of the sample data identified three subseries, containing nine plant associations in the Jeffrey pine series (Table 5). The highest number of plant associations were identified on the Gasquet and Lower Trinity Ranger Districts (6), followed by the Orleans Ranger District (5), Happy Camp Ranger District (4), Mad River, Ukonom, and Corning Ranger Districts (2), and the Salmon River, and Upper Lake Ranger Districts (1). Sampling is continuing on the Klamath National Forest and additional plant associations will likely be identified and added to this guide.

The plant associations of the Jeffrey pine series were arrayed along elevation/ moisture/parent material gradients (fig.12) and differed from one another by elevation, distance from the ocean, surface and subsurface pH, slope percent, surface gravel and rock, total soil depth, A horizon thickness, and bare ground percent. Elevation ranged from 920 to 6300 feet and influenced soil temperature and the length of the growing season. Sites were mostly rocky, in ridgetop and upper one-third slope positions that ranged from 0 to 67% steepness. Jeffrey pine plant associations were found on all aspects, but with higher frequency on dry, south facing slopes, which may be moderated in coastal associations by the cooling effects of the Pacific Ocean. Distance from the ocean varied by plant association from 10.4 miles to 36.8 miles. It was a key variable in discriminating between plant associations due to its influence on moisture conditions. Stands found near the ocean were often subjected to coastal fog which provided both a cooling influence as well as additional moisture to the site. Inland stands appeared much drier and warmer, which was reflected in their species composition. Parent material was primarily peridotite and serpentinite with the exception of the Jeffrey Pine-White Fir/Iris type which was found on soils derived from sandstone parent material. Surface and subsurface pH ranged from 5.2 to 8.0 and were indicators of parent material origin and soil development. Stands on sandstone parent material had a mean pH of 6.0, compared to those on serpentine which averaged 7.5. Soil development was also affected by slope position. In addition, soils in ridgetop or spur ridge positions were of lower development than those in lower slope positions due to continuous soil loss in ridgetop sites versus accumulation in lower slope positions.

Plant associations in the Jeffrey pine series were arranged along the environment gradients described above as follows. The Jeffrey pine/Idaho fescue type was found on the lowest elevation, cool sites, with gentle slopes, in close proximity to the ocean (fig. 12). It was followed on mid elevation, cool sites by the Jeffrey Pine-White Fir/Sadler Oak/Beargrass type and on high elevation cool sites by the Jeffrey Pine-White Fir/Iris type. Slightly farther inland on high elevation, cool, dry sites, the Jeffrey Pine/Huckleberry Oak-Pinemat Manzanita/Idaho Fescue type was found. These four plant associations fall into a group that are described as

Table 5. Plant associations found in the Jeffrey Pine series.

EDP CODE	PLANT ASSOCIATION NAME
PIJE-ABCO Sub-series	Jeffrey Pine-White Fir
PIJE-ABCO/IRI	Jeffrey Pine-White Fir/Iris
PIJE-ABCO/QUSA/XETE	Jeffrey Pine-White Fir/Sadler Oak/ Beargrass
PIJE-PSME Sub-series	Jeffrey Pine-Douglas-fir
PIJE-PSME/QUVA/FECA	Jeffrey Pine-Douglas-fir/Huckleberry Oak/California Fescue
PIJE/FEID//Grass Sub-series	Jeffrey Pine/Idaho Fescue//Grass
PIJE/FEID	Jeffrey Pine/Idaho Fescue
PIJE/QUVA-ARNE2/FEID	Jeffrey Pine/Huckleberry Oak-Pinemat Manzanita/Idaho Fescue
PIJE-CADE3 Sub-series	Jeffrey Pine-Incense Cedar
PIJE-CADE3-ABCO/QUVA	Jeffrey Pine-Incense Cedar-White Fir/Huckleberry Oak
PIJE-CADE3/QUVA/XETE	Jeffrey Pine-Incense Cedar/ Huckleberry Oak/Beargrass
PIJE-CADE3/CEPU	Jeffrey Pine-Incense Cedar/Dwarf Ceanothus
PIJE-CADE3/CECU	Jeffrey Pine-Incense Cedar/Buckbrush

cool due to distance from the ocean and elevation. They were discriminated from one another by elevation, distance from the ocean, surface and subsurface pH, slope, soil depth, surface gravel and rock, along with bare ground percent. The mid elevation sites with intermediate moisture conditions contained the Jeffrey Pine-Douglas-fir/Huckleberry Oak/California Fescue type. The low elevation, dry, warm sites were represented by the Jeffrey Pine-Incense Cedar/Buckbrush type. The mid elevation, dry, warm sites included the Jeffrey Pine-Incense Cedar/ Huckleberry Oak/Beargrass and Jeffrey Pine-Incense Cedar-White Fir/Huckleberry Oak types. The high elevation, dry, warm sites included the Jeffrey Pine-Incense Cedar/Siskiyou mat type. This warm/dry group is discriminated from one another by distance from the ocean, AWC, elevation, soil depth, A horizon thickness, and slope percent.

Soils in the Jeffrey pine series were primarily derived from peridotite or serpentinite parent rocks with the exception of the Jeffrey pine-white fir/iris type. It was found on soils derived from sandstone parent material. Surface soil pH varied from moderately acidic (6.0) to slightly alkaline (7.5). This variation in pH was related to topographic position and parent material. For instance, soils with lower pH were invariably found in sites where soil tends to accumulate due to colluvial movement and has greater development, while sites with higher pH tended to be in areas where new surfaces are continuously exposed and have little soil development. Soil depth also varied by plant association, it was mainly moderately deep to shallow and along with AWC and A horizon thickness was reflective of productivity. For instance the Jeffrey Pine-White Fir/Iris type had the second highest mean soil depth of 34", the highest mean AWC of 3.2 inches, and the thickest A horizon of 13 inches. Productivity in this type was the highest of all

plant associations in the Jeffrey pine series with a mean softwood volume of 11,377 ft.^{3} and softwood basal area of 306 ft.^{2}, as well as the highest stand density index of 458. In contrast, the Jeffrey Pine/Huckleberry Oak-Pinemat Manzanita/Idaho Fescue type had the shallowest soils in the series, with a mean soil depth of 16", the lowest AWC of 1.6 inches, and the second lowest A horizon thickness of 5 inches. It also had the lowest softwood volume 1186 ft.^{3} and softwood basal area 81 ft.^{2}, along with the lowest stand density index of 145.

Stand structure also varied by plant association as a result of soils and topographic position. The Jeffrey Pine-White Fir/Sadler Oak/Beargrass type had the tallest mean tree height in the top and second layers with means of 141 and 112 feet. It also had the second largest mean diameter in the top layer 40 inches dbh and largest diameter in the second layer 29 inches dbh. In contrast, the Jeffrey Pine/Huckleberry Oak-Pinemat Manzanita/Idaho Fescue type had the shortest mean tree height of 48 feet in the top layer and smallest mean diameter of 20 inches dbh, as well as the shortest mean height of 42 feet in the second layer.

Vegetation composition reflects the variable environments described above. For instance, the Jeffrey Pine-White Fir subseries is found on high elevation cool sites. White fir is the indicator species that identifies this high elevation subseries. Within the subseries on mesic sites subject to coastal fog and in close proximity to the Pacific Ocean, Sadler Oak is the indicator species. It distinguishes the Jeffrey Pine-White Fir/ Sadler Oak/Beargrass plant association from all others in the series. Other indicator species include Douglas-fir and California fescue on mesic sites, they identify the Jeffrey Pine-Douglas-fir/Huckleberry Oak/California Fescue type. Dry sites within the Jeffrey pine series are distinguished by high cover of incense cedar, huckleberry oak, Siskiyou mat (*Ceanothus pumilus*), buckbrush (*Ceanothus cuneatus*), and common juniper. They identify the Jeffrey Pine-Incense Cedar/Buckbrush, Jeffrey Pine-Incense Cedar/Huckleberry Oak/ Beargrass, Jeffrey Pine-Incense Cedar-White Fir/Huckleberry Oak, and Jeffrey Pine-Incense Cedar/Siskiyou mat types.

Age class distribution is used here as an indicator of disturbance in the form of stand replacing fires. The highest frequency of stand replacing fires, based on youngest mean stand age and highest frequency of stands below 200 years stand age, was the Jeffrey Pine/Idaho Fescue type. It has a dense grass layer and moderate shrub layer that provide ladder fuels that tend to contribute to stand replacing fires. It was followed in stand replacing fire frequency by the Jeffrey Pine-Incense Cedar/ Huckleberry Oak/Beargrass type and the Jeffrey Pine-Douglas-fir/Huckleberry Oak/California Fescue type. Both of these associations have dense shrub layers composed of huckleberry oak, which contributes high flame lengths when dry and leads to fires of stand replacing intensity. Next in stand replacing fire frequency, is the Jeffrey Pine-Incense Cedar/ Buckbrush type. It has a dense shrub layer and is located on ridgetops and spur ridges that are droughty in nature, which contributes to the high frequency of stand replacing fires. The Jeffrey Pine/Huckleberry Oak-Pinemat Manzanita/Idaho Fescue type begins a group of plant associations with substantially lower frequencies of stand replacing fires. It has a patchy distribution of shrubs and grasses, along with a high percent of bare ground that inhibits fire spread. The Jeffrey Pine-White Fir/Iris, Jeffrey Pine-Incense Cedar-White Fir/Huckleberry Oak, and Jeffrey Pine-White Fir/Sadler Oak/Beargrass types all have been subjected to similar, low frequencies of stand replacing fires. This is probably related to their mesic, upslope positions where summer rainfall often occurs. The lowest frequency of stand replacing fires occurred in the Jeffrey Pine-Incense Cedar/ Siskiyou mat type. This high elevation type had low vegetation cover and a high

percentage of bare ground which discourages fire spread and adds to the low frequency of stand replacing fires.

The Jeffrey pine series had the highest frequency of sensitive and rare plants of any forest series in northwest California. The series included the sensitive plants McDonald's rock cress, Waldo rock cress (*A. aculeolata*), Waldo buckwheat, Howell's jewelflower (*Streptanthus howellii*),pale yellow stonecrop, the Lassics sandwort (*Minuartia decumbens*), yellow tubered toothwort, Koehler's stipitate rock cress (*Arabis koehleri* var. *stipitata*), Sonoma manzanita (*Arctostaphylos canescens* ssp. *sonomensis*), Oregon bleeding heart (*Dicentra formosa* ssp. *oregana),* and the rare plants, serpentine arnica (*Arnica cernua*), Bolander's lily (*Lilium bolanderi*), Howell's lomatium (*Lomatium howellii*), evergreen everlasting (*Antennaria suffrutescens*), Washington lily (*Lilium washingtonianum* ssp. *purpurascens*), Peck's sanicle (*Sanicula peckiana*), Heckner's stonecrop (*Sedum laxum* ssp. *heckneri*), Siskiyou Mountain ragwort (*Senecio macounii*), Hoffman's onion (*Allium hoffmanii),* Siskiyou onion (*Allium siskiyouense*), short lobed indian paintbrush(*Castilleja hispida* ssp. *brevilobata*), Howell's horkelia*(Horkelia sericata),* Del Norte County iris *(Iris innominata),* Howell's sandwort *(Minuartia howellii),* timber bluegrass *(Poa piperi),* Del Norte pyrrocoma *(Pyrrocoma racemosa* ssp. *congesta*), Howell's hispidula *(Arctostaphylos hispidula),* and yellow inside-out flower *(Vancouveria chrysantha).*

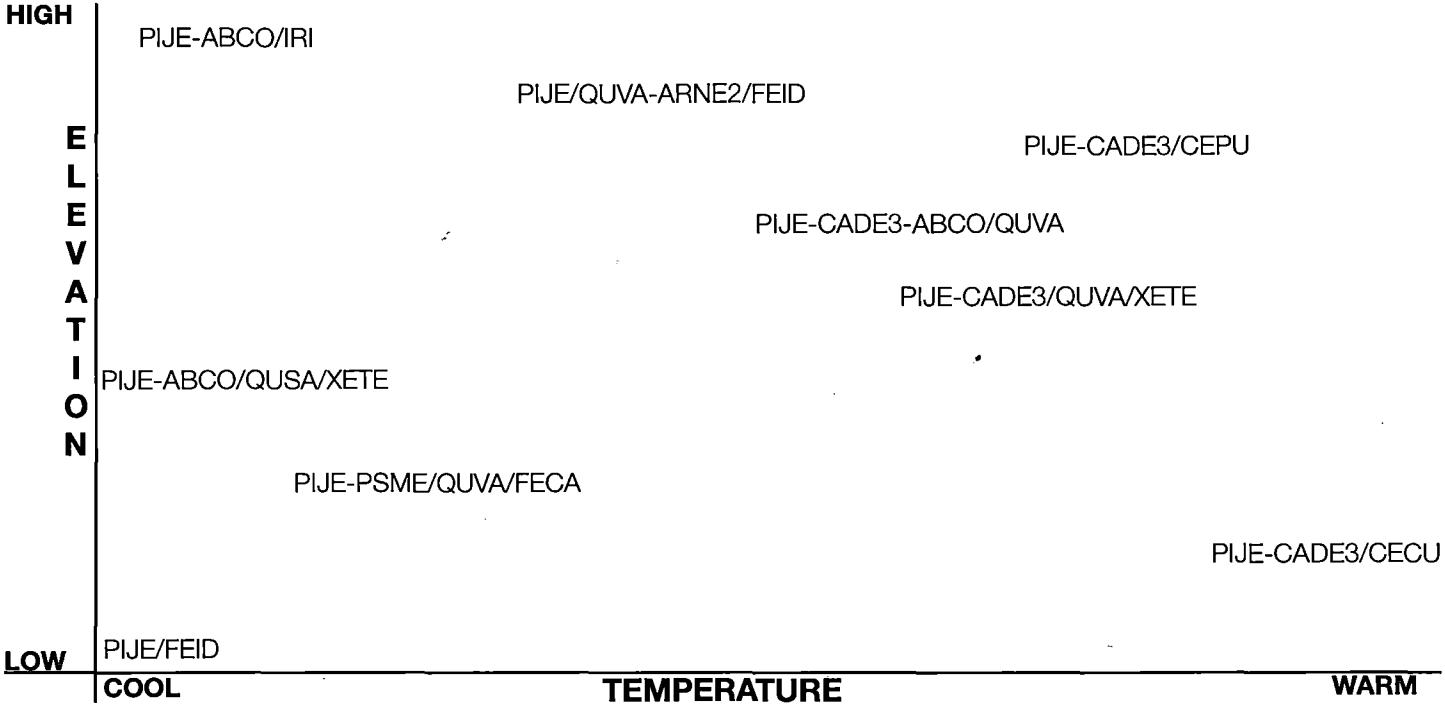


FIGURE 12. Relative relationships of plant association in the Jeffrey Pine Series based on elevation and temperature.

Jeffrey Pine Series Key

1 a. White fir present 2

2 a. Sadler oak cover ≥ 10% ..... PIJE-ABCO/QUSA/XETE

2 b. Sadler oak absent or not as above 3

3 a. Iris present huckleberry oak absent ..... PIJE-ABCO/IRI

3 b. Not as above 4

1 b. White fir absent 4

4 a. Herb layer dominated by grass 5

5 a. Idaho fescue cover ≥ 10% 6

6 a. Buckbrush ≥ 10% and huckleberry oak absent .....
..... PIJE-CADE3/CECU

6 b. Not as above 7

7 a. Elevation > 3000 feet, habitat typically ridgetops or saddles .....
..... PIJE/QUVA-ARNE2/FEID

7 b. Elevation < 3000 feet, habitat typically elevated terraces.....
..... PIJE/FEID

5 b. Idaho fescue absent or not as above 8

8 a. Huckleberry oak and California fescue cover ≥ 10%
..... PIJE-PSME/QUVA/FECA

8 b. Huckleberry oak or California fescue absent or not as above 9

4 b. Grass absent or not as above 9

9 a. Buckbrush present and huckleberry oak absent .....
..... PIJE-CADE3/CECU

9 b. Buckbrush absent or not as above 10

10 a. Siskiyou mat cover ≥ 10% PIJE-CADE3/CEPU

10 b. Siskiyou mat absent or not as above ... 11

11 a. Huckleberry oak cover ≥ 10% 12

12 a. White fir present PIJE-CADE3-ABCO/QUVA

12 b. White fir absent PIJE-CADE3/QUVA/XETE

11 b. Huckleberry oak absent or not above .....
..... Return to step 1 and try the key again

Jeffrey Pine/Idaho Fescue
PIJE/FEID Association
EcoCode CPJGNFI11

Idaho fescue
(*Festuca idahoensis*)

Jeffrey Pine/Idaho Fescue
PIJE/FEID Association, EcoCode CPJGFI11

SUMMARY TABLE

(Sample Size: 19)		COVER	CON
Tree Overstory Layer			
PIJE	Jeffrey Pine	22	100
PSME	Douglas-Fir	2	52
UMCA1	California Bay	1	26
Tree Understory Layer			
PIJE	Jeffrey Pine	1	100
PSME	Douglas- Fir	1	31
Shrubs			
CEPR	Squawcarpet	2	100
ARNE2	Pinemat Manzanita	4	84
HODI	OceanSpray	2	89
QUVA	Huckleberry Oak	3	57
Herbs & Grasses			
FEID	Idaho Fescue	55	100
FECA	California Fescue	9	94
ACLA2	Common Yarrow	1	94
CAS-3	Indian Paintbrush	1	84

Environment

Elevation: 1740-2440 ft.

Aspect: S.E., S.W., N.W.

Slope: 3-30%

Slope Position: ridgetop & upper 1/3

Surface Rock: 1-40%

Soils

Pit Depth: 11-40"+

Coarse Fragments: 10-62%

Textures: gl, gcl

Parent Material: serpentinite, peridotite

Distribution/Environment

The Jeffrey Pine/Idaho Fescue type was found primarily on the Gasquet Ranger District with an outlier identified on the Happy Camp Ranger District. Mean distance to the Pacific Ocean was 10.4 miles, closest of all types in the Jeffrey pine series. Slope position were flattened ridgetops of the Klamath peneplain and upper one-third slopes. Elevation averaged 2002 feet, lowest of all series, with a narrow range from 1740 to 2440 feet. Slopes were gentle (14%), southwest and southeast facing, and radiation index was high (.500) as a result of south facing aspects.

Soil Summary

Soils in this type were derived from serpentinite and peridotite parent rocks. These rocks appear to be of relatively recent origin which helps explain their (could be more influenced by degree of serpentinization of parent rock or development of soil--loss of Mg as soil develops) as neutral surface pH of 7.3 and slightly alkaline subsurface pH of 7.4. Soils here were well drained (63%) and somewhat excessively drained (37%), shallow (47%), moderately deep (48%), and deep (5%), loams to gravelly loams, with a moderate AWC (2.1"), moderately thick A horizons (7"), and moderate A horizon coarse fragments (25%). They were found in the mesic soil temperature regime and were of low productivity for conifer growth. The dominant soil families were loamy skeletal, serpentinitic, mesic, lithic, Ultic Haploxerolls (63%) and loamy skeletal, serpentinitic, mesic, Typic Xerochrepts (37%).

Vegetation

Total vegetation ranged from 48-99% with an average of 82%. Overstory cover of 24% was the second lowest of all Jeffrey pine plant associations. The dominant overstory species was Jeffrey pine (22%), with Douglas-fir (2%) as an occasional associate. The regeneration layer included Jeffrey pine (1%) and Douglas-fir (1%). The shrub layer had the second lowest average cover (10%) of all Jeffrey pine plant associations. The shrub layer included occasional occurrences of huckleberry oak (3%), pinemat manzanita (4%), Pacific serviceberry (1%), coffeeberry (2%), squawcarpet (2%), and oceanspray (2%). The forb layer was the second highest in the Jeffrey pine series, with a mean cover of 19%. It often included mountain yarrow (*Achillea lanulosa*) (1%), buttercup (*Ranunculus* sp.) (1%), indian paintbrush (*Castilleja* sp.) (1%), false bindweed (*Calystegia* sp.) (1%), indian's dream (*Aspidotis densa*) (1%), aster (*Aster* sp.) (1%), and Howell's horkelia (20%). The grass layer was the highest of all series (63%), it was dominated by Idaho fescue (55%), with California fescue (9%) as an associate species.

Disturbance and Age Class Distribution

Stands found in this type had the youngest stand ages of all types in the Jeffrey pine series. They ranged in age from 78 to 342 years with an average age of 166 years. The highest frequency of stands (64%) were found in stands less than 176 years of age. The frequency of stands above 300 years was 5% and the frequency of stands below 200 years was 79%. This uneven distribution of stands by age class category indicates that stand replacing fires have occurred with high frequency, particularly in the period between 1770 and 1947. Fire intensity between 1947 and 1995 appears to have been restricted to low intensity, non-stand replacing events.

Stand Structure Summary

This type is best described as very open stands with dense grass cover. The tree layer is a sparse mixture of stunted, flat topped, uneven-aged, intolerant tree

species, from a variety of diameter and age classes, which often resulted in multiple layers. Due to the open nature of the overstory distinct layers are difficult to recognize. However, there usually were at least three layers of different aged conifers present. All layers were dominated by Jeffrey pine. The top layer had an average height of 76 feet and diameter of 22 inches. The second layer had an average height of 57 feet and diameter of 15 inches. The height and diameter of the third layer averaged 45 feet and 11 inches respectively.

Softwood cubic volumes range from extremely low to low values with an average of 2250 $ft.^3$ which is well below the average for all types in the Jeffrey pine series (4,758 $ft.^3$). Basal area also ranged from very low to low with an average of 85 $ft.^2$, this was also well below the average for the series of 169 $ft.^2$. Dunning site class was 5 with site index of 75 at 300 years. Stand density index was also very low with an average of 145, which is the lowest of all types in the Jeffrey pine series.

Successional Trends

The Jeffrey Pine/Idaho Fescue type has a moderate potential for alteration of its successional pathway with continued fire suppression. It appears to be effecting the herb layer as evidenced by invasion from shrub species such as huckleberry oak and pinemat manzanita. This may have the effect of reducing the amount of area available for herbaceous species to successfully compete and could effect populations of the sensitive and rare plants that occur here.

Rare Plant Relationships

The Jeffrey Pine/Idaho Fescue type contains the highest frequency of Sensitive and rare plants of all forested plant associations. The sensitive plants found in this type included McDonald's rockcress, Waldo buckwheat, pale-yellow stonecrop, Oregon bleeding heart, and yellow tubered toothwort. The rare plants found in this type included Peck's Sanicle, Heckner's stonecrop, Siskiyou Mountain ragwort, and Howell's horkelia, evergreen everlasting, Howell's hispidula, serpentine arnica, short lobed indian paintbrush, Del Norte County iris, Howell's lomatium, Howell's sandwort, timber bluegrass, and Del Norte pyrrocoma.

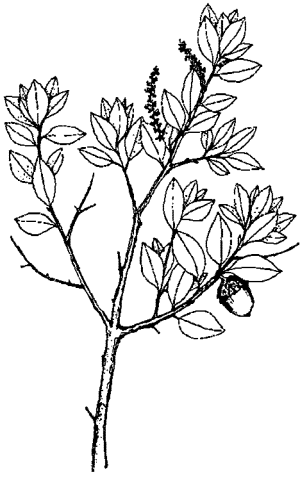
Management Implications

The Jeffrey Pine/Idaho Fescue type has the highest diversity of plant species in the Jeffrey pine series. This type contributes significantly to the biodiversity of serpentine soils. The harsh environment on these sites, limits options available for management treatments. Due to the high frequency of sensitive and rare plants and the high density of native grasses, management should be directed at maintaining these valued attributes.

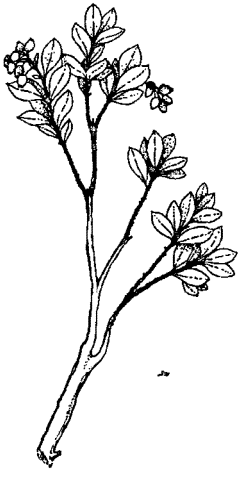
Closely Related Types

The Jeffrey Pine/Idaho Fescue type is often found upslope from the Jeffrey Pine-Incense Cedar/Huckleberry Oak/Beargrass type. Site conditions in the Jeffrey Pine-Incense Cedar/Huckleberry Oak/Beargrass type are somewhat better than those in the Jeffrey Pine/Idaho Fescue type due to colluvial action resulting in deeper soils. This is also reflected in softwood productivity which is also somewhat higher. On upland sites, particularly in ridgetop positions the Jeffrey Pine/Idaho Fescue type is replaced by the Jeffrey Pine/Huckleberry Oak-Pinemat Manzanita/Idaho Fescue type.

Jeffrey Pine/Huckleberry Oak-Pinemat Manzanita/Idaho Fescue
PIJE/QUVA-ARNE2/FEID Association
EcoCode CPJGFI12

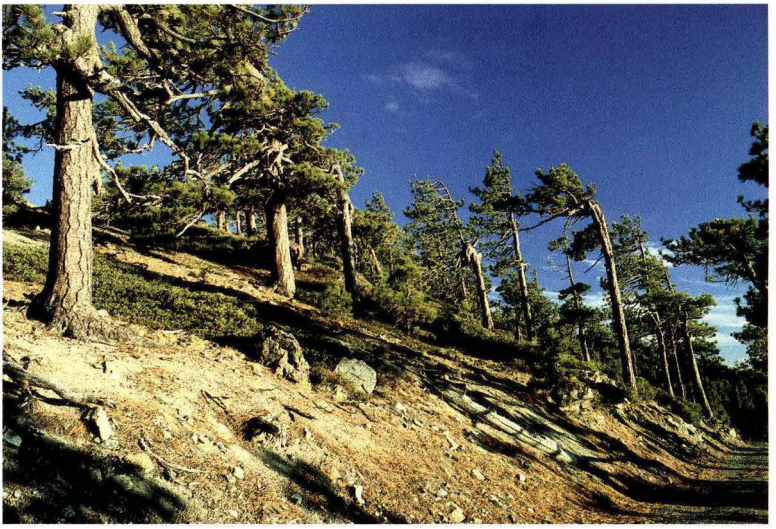


huckleberry oak
(Quercus vaccinifolia)



pinemat manzanita
(Arctostaphylos nevadensis)

Jeffrey Pine/Huckleberry Oak-Pinemat Manzanita/Idaho Fescue PIJE/QUVA-ARNE2/FEID Association, EcoCodeCPJGFI12



SUMMARY TABLE

(Sample Size:12)		COVER	CON
Tree Overstory Layer			
PIJE	Jeffrey Pine	14	100
PIMO3	Western White Pine	3	50
PSME	Douglas-Fir	1	41
Tree Understory Layer			
PIJE	Jeffrey Pine	1	100
PICO-1	Lodgepole Pine	1	50
PSME	Douglas-Fir	1	41
Shrubs			
ARNE2	Pinemat Manzanita	13	83
QUVA	Huckleberry Oak	11	75
JUCO	Common Juniper	3	33
Herbs & Grasses			
FEID	Idaho Fescue	11	100
Tolmie's startulip		1	58
PHDI-4	Spreading Phlox	1	50
FECA	California Fescue	19	41

Environment

Elevation: 3750-5280 ft.

Aspect: S.E., S.W., N.W.

Slope: 18-32%

Slope Position: ridge top

Surface Rock: 5-32%

Soils

Pit Depth: 2-28"

Coarse Fragments: 10-45%

Textures: l, sl

Parent Material: serpentinite, peridotite

Distribution/Environment

The Jeffrey Pine/Huckleberry Oak-Pinemat Manzanita/Idaho Fescue type was found on the Gasquet, Lower Trinity, Ukonom, and Happy Camp Ranger Districts. Mean distance to the Pacific Ocean was 21.5 miles in these harsh, ridgetop slope positions. Elevation averaged 4379 feet and ranged from 3460 to 5560 feet, among the highest in the Jeffrey pine series. Slopes were moderate (22%), west and south facing, with high radiation index (.505).

Soil Summary

Soils in this type were derived from serpentinite and peridotite parent rocks. These soils were poorly developed, with slightly alkaline surface and subsurface pH's of 7.5 and 7.7 respectively. Bare serpentine soil was a characteristic of this type, it ranged from 1 to 75% and averaged 19%. Soils were well drained (100%), shallow (60%) and moderately deep (40%), loams to sandy loams, with the lowest mean AWC (1.6") in the Jeffrey pine series, thin A horizons (4"), and moderate A horizon coarse fragments (22%). They were found in the frigid soil temperature regime and were of very low productivity for conifer growth. The harsh environment and low soil development in this type are reflected in the high frequency of soils in the order Entisol. The dominant soil families were loamy skeletal, mixed, frigid, lithic, Xerorthents (45%) and loamy skeletal, serpentinitic, frigid, lithic and typic Xerochrepts (45%).

Vegetation

Total vegetation ranged from 25-88%, lowest in the Jeffrey pine series, with an average of 60%. Overstory cover of 18% was the lowest of all Jeffrey pine plant associations. The dominant overstory species was Jeffrey pine (14%), with incense cedar (4%), western white pine (3%), lodgepole pine (6%), and Douglas-fir (1%) as occasional associates. The regeneration layer was dominated by Jeffrey pine (1%), with infrequent occurrences of incense cedar (1%), and Douglas-fir (1%). The shrub layer was irregular in cover, it had the third lowest average cover of all Jeffrey pine plant associations, 29%. It included huckleberry oak (11%), pinemat manzanita (13%), and occasional occurrences of Siskiyou mat (3%), Pacific serviceberry (2%), and common juniper (3%). The forb layer had high species diversity but low cover, with a mean cover of 6%. Herbs found in this type included Tolmie's star tulip (*Calochortus tolmiei*) (1%), spreading phlox (*Phlox diffusa*) (1%), stonecrop (*Sedum* sp.) (1%), cutleaf silverpuffs (*Microseris laciniata*) (1%), leafy fleabane (*Erigeron foliosus*) (1%), Siskiyou onion (1%), bigseed biscuitroot (*Lomatium macrocarpum*) (1%), bedstraw (*Galium* sp.) (1%), and Lee's bitterroot (*Lewisia leana*) (1%). The grass layer cover was among the highest in the Jeffrey pine series (22%), it was dominated by Idaho fescue (11%), with California fescue (19%) and Geyer's oniongrass (*Melica geyeri*) (1%) as occasional associate species.

Disturbance and Age Class Distribution

Stands found in this type had their age class distribution shifted toward the middle part of the age class range. They ranged in age from 77 to 418 years with an average age of 219 years. The highest frequency of stands (50%) were found in stands 176 and 275 years of age. The frequency of stands above 300 years was 17% and the frequency of stands below 200 years was 33%. This uneven distribution of stands by age class category indicates that stand replacing fires have occurred infrequently during the last 200 years, with a higher frequency in the period between 1720 and 1820. Due to the amount of bare ground, this type would burn in a patchy manner and generally be restricted to low intensity, non-stand replacing events.

Stand Structure Summary

This type is best described as patchy, with stunted, flat topped, scattered, very open stands with interspersed patches of shrubs and grass cover. The tree layer is a very sparse mixture of uneven-aged, intolerant tree species, from a variety of

diameter and age classes, which often resulted in multiple layers. Due to the open nature of the scattered overstory, distinct layers are difficult to recognize. However, there usually are at least three layers of different aged conifers present. All layers were dominated by Jeffrey pine with lodgepole pine as an associate understory species. The top layer had an average height of 48 feet and diameter of 20 inches, lowest in the Jeffrey pine series. The second layer had an average height of 42 feet and diameter of 18 inches. The height and diameter of the third layer averaged 26 feet and 11 inches respectively.

Softwood cubic volume ranged from extremely low to very low values with an average of 1186 $ft.^3$ which is well below the average for all types in the Jeffrey pine series (4,758 $ft.^3$). Basal area also ranged from very low to low with an average of 81 $ft.^2$, this was also well below the average for the series of 169 $ft.^2$. Dunning site class was 5 with site index below the lowest value in the site class table of 75 feet at 300 years. It is probably more like 50 feet at 300 years. Stand density index was also very low with an average of 145, which is the lowest of all types in the Jeffrey pine series.

Successional Trends

The Jeffrey Pine/Huckleberry Oak-Pinemat Manzanita/Idaho Fescue type has a low potential for alteration of its successional pathway with continued fire suppression. Successful regeneration of Jeffrey pine and its presence in all layers on extremely harsh sites indicates that this species should remain as a dominant component. Lodgepole pine presence as an associate species indicates that patchy low intensity fires are occurring with sufficient frequency to maintain it as a component of these high elevation sites. It also indicates that should stand replacing fires occur that lodgepole pine could dominate these sites during the early part of the successional sere.

Rare Plant Relationships

The Jeffrey Pine/Huckleberry Oak-Pinemat Manzanita/Idaho Fescue type contains the second highest frequency of sensitive and rare plants of all forested plant associations. The sensitive plants found in this type included Koehler's rock cress, McDonald's rock cress, Waldo buckwheat, yellow tubered toothwort, Waldo rock cress, Howell's jewelflower, and pale-yellow stonecrop. The rare plants included Howell's horkelia, Siskiyou onion, Howell's lomatium, Howell's sandwort, yellow inside-out flower, Peck's sanicle, and Heckner's stonecrop.

Management Implications

The Jeffrey Pine/Huckleberry Oak-Pinemat Manzanita/Idaho Fescue type has a high diversity of plant species and has a high cover of native perennial grasses. This type contributes significantly to the overall biodiversity of serpentine areas. The harsh environment on these sites, limits options available for management treatments. Due to the high frequency of sensitive and rare plants, management should be directed at maintaining these valued attributes.

Closely Related Types

The Jeffrey Pine/Huckleberry Oak-Pinemat Manzanita/Idaho Fescue type is often found upslope from the Jeffrey Pine/Idaho Fescue, Jeffrey Pine-Incense Cedar/Huckleberry Oak/Beargrass and Jeffrey Pine-Incense Cedar-White Fir/Huckleberry Oak types. Site conditions in all three types are somewhat better than those in the Jeffrey Pine/Huckleberry Oak-Pinemat Manzanita/Idaho Fescue type due to colluvial action resulting in deeper soils. This is also reflected in softwood productivity which is also over two times as high in the latter two types. The serpentine barren type is also found adjacent to the Jeffrey Pine/Huckleberry Oak-Pinemat Manzanita/Idaho Fescue type in upslope positions. Here conditions are so harsh as to prevent successful tree occupation and the type is classified as non-forest.

Jeffrey Pine-Douglas Fir/Huckleberry Oak/California Fescue PIJE-PSME/QUVA/FECA Association EcoCode CPJCD011

California fescue
(Festuca californica)

Jeffrey Pine-Douglas fir/Huckleberry Oak/ California Fescue
PIJE-PSME/QUVA/FECA Association, EcoCodeCPJCD011

SUMMARY TABLE

(Sample Size:11)

		COVER	CON
Tree Overstory Layer			
PIJE	Jeffrey Pine	25	100
PSME	Douglas-Fir	17	100
CADE3	Incense Cedar	13	90
PILA	Sugar Pine	6	63
Tree Understory Layer			
PIJE	Jeffrey Pine	2	100
PSME	Douglas-Fir	1	100
CADE3	Incense Cedar	2	81
Shrubs			
QUVA	Huckleberry Oak	29	100
ARNE2	Pinemat Manzanita	8	54
AMAL	Pacific Serviceberry	2	54
Herbs & Grasses			
FECA	California Fescue	33	100
XETE	Beargrass	5	54
FEID	Idaho Fescue	5	36

Environment

Elevation: 1840-5560 ft.

Aspect: N.E.,S.W.

Slope: 8-65%

Slope Position:ridgetop, middle,& upper 1/3

Surface Rock: 0-25%

Soils

Pit Depth: 9-34"

Coarse Fragments:10-45%

Textures: gl, l

Parent Material: serpentinite, peridotite

Distribution/Environment

The Jeffrey Pine-Douglas-fir/Huckleberry Oak/California Fescue type had a wide distribution, it was found on the Lower Trinity, Gasquet, Orleans, Happy Camp, and Ukonom Ranger Districts. Mean distance from the Pacific Ocean was 25.6 miles, which contributes to a hot/dry environment in these ridgetop, upper and middle one-third slope positions. Elevation averaged 3614 feet and ranged from 1840 to 5560 feet, which was one of the widest ranges of all Jeffrey pine plant associations. Slopes were the steepest in the series (34%), and were northeast and southwest facing. Radiation index averaged .480 due to the northeast facing plots, but was much higher on southwest facing slopes.

Soil Summary

Soils in this type were derived from serpentinite and peridotite parent rocks, leading to neutral surface pH of 6.7 and subsurface pH of 6.8. They were well drained (87%) and somewhat excessively well drained (13%), shallow (62%), moderately deep (25%), and deep (13%), gravelly loams and gravelly clay loams, with a moderate mean AWC (2.3"), thin A horizons (4"), and moderate A horizon coarse fragments (27%). They were found in the mesic soil temperature regime and were of low productivity for conifer growth. The dominant soil families were fine loamy, serpentinitic, mesic, lithic, Typic Xerochrepts (37%), fine loamy, serpentinitic, mesic, Lithic or Mollic Haploxeralfs (37%), and fine loamy, serpentinitic, mesic, Typic Argixerolls.

Vegetation

Total vegetation ranged from 70-99% with an average of 86%, among the highest in the Jeffrey pine series. Overstory cover of 56% was in the middle of all Jeffrey pine plant associations. The dominant overstory species were Jeffrey pine (25%) and Douglas-fir (17%), with incense cedar (13%) and sugar pine (6%) as frequent codominants. The regeneration layer included Jeffrey pine (2%), incense cedar (2%), and Douglas-fir (1%) which occasionally has much higher cover. The shrub layer had the third highest average cover of all Jeffrey pine plant associations, 41%. It was dominated by huckleberry oak (29%), which can occasionally have low cover (2%). Other associate shrub species include pinemat manzanita (8%), Pacific serviceberry (2%), creeping Oregon-grape (1%), and buckbrush (*Ceanothus cuneatus*) (3%. The forb layer was low with a mean cover of 7%. It was dominated by beargrass (5%) and often included iris (1%), and mules ears (*Wyethia* sp.) (5%). The grass layer had the second highest cover in the series with a mean cover of 36%. It was dominated by California fescue (36%), with Idaho fescue (5%) as a frequent associate.

Disturbance and Age Class Distribution

Stands found in this type show a shift towards dominance by younger age classes. Stand age ranged from 28 to 453 years with an average age of 216 years, among the youngest in the Jeffrey pine series. This is probably due to the higher frequency of stand replacing fires occurring on these hot/dry upland sites. The frequency of stands by age class was evenly distributed below 276 years. The frequency of stands above 300 years was 20%, compared to 50% below 200 years stand age. This indicates the higher frequency of stand replacing fires that occur in this type, particularly in the period from 1720 to 1965.

Stand Structure Summary

This type also had a moderately dense mixture of uneven-aged, moderately tolerant and intolerant tree species, from a variety of diameter and age classes, resulting in multiple layers. The overstory is usually composed of at least two

layers of different aged conifers. The top layer was dominated by Jeffrey pine and Douglas-fir and had an average height of 84 feet and diameter of 24 inches. The second layer was dominated by Douglas-fir, incense cedar, sugar pine, and Jeffrey pine, it had an average height of 49 feet and diameter of 11 inches.

Softwood cubic volume was generally low and ranged from low to moderate with an average of 3,706 $ft.^3$ which is below the average for all types in the Jeffrey pine series (4,758 $ft.^3$). Basal area also ranged from low to moderate with an average of 172 $ft.^2$, this compared to the average for the series of 169 $ft.^2$. Dunning site class was 5 with site index of 75 at 300 years. Stand density index was moderate with an average of 270, which is among the middle of all types in the Jeffrey pine series.

Successional Trends

The Jeffrey Pine-Douglas-fir/Huckleberry Oak/California Fescue type has a moderate potential for alteration of its successional pathway with continued fire suppression. Some of the stands visited showed high cover of Douglas-fir in the regeneration layer and second tree layer indicating that lack of fire was influencing stand structure. In general however, the moderate overstory cover combined with a higher frequency of stand replacing fires and occasional low intensity ground fires appear to be favoring Jeffrey pine and suppressing Douglas-fir in the competition to successfully reproduce.

Rare Plant Relationships

The rare species Bolander's lily was found in the Jeffrey Pine-Douglas-fir/ Huckleberry Oak/California Fescue type. This species appears to do well in plant associations with high shrub cover. This could possibly indicate a need for the higher surface moisture or lower soil temperatures provided by the high shrub cover on these hot dry sites.

Management Implications

The Jeffrey Pine-Douglas-fir/Huckleberry Oak/California Fescue type is generally of low productivity. This restricts management opportunities to those associated with rare plant habitats, grazing and browsing by wildlife, and cover for small mammals. In those situations where Douglas-fir appears to be out competing Jeffrey pine, cool, spring, broadcast burns could be used to reduce Douglas-fir cover in the understory and stimulate new grass growth.

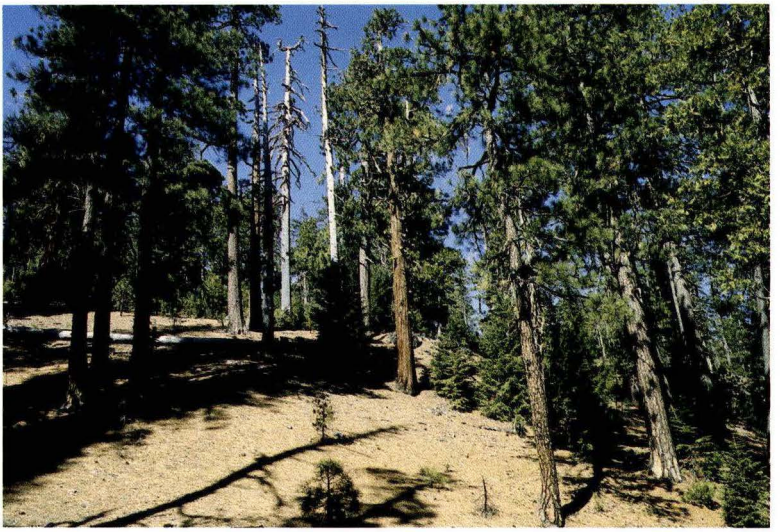
Closely Related Types

The Douglas-fir/Huckleberry Oak type was found adjacent to the Jeffrey Pine-Douglas-fir/Huckleberry Oak/California Fescue type in concavities or areas where soil tends to accumulate and site conditions are somewhat less harsh.

Jeffrey Pine-White Fir/Iris
PIJE-ABCO/IRI Association
EcoCode CPJCFW11

Iris sp.
(Iris sp.)

Jeffrey Pine-White Fir/Iris
PIJE-ABCO/IRI Association,EcoCode CPJCFW11



SUMMARY TABLE

(Sample Size:15)		COVER	CON
Tree Overstory Layer			
PIJE	Jeffrey Pine	25	100
ABCO	White Fir	30	100
CADE3	Incense Cedar	9	71
PSME	Douglas-fir	14	40
Tree Understory Layer			
ABCO	White Fir	3	100
CADE3	Incense Cedar	3	46
PIJE	Jeffrey Pine	1	35
QUCH2	Canyon Live Oak	4	46
PSME	Douglas-fir	1	33
PILA	Sugar Pine	1	33
Shrubs			
SYMO	Creeping Snowberry	1	60
ROGY	Wood Rose	2	46
COCOC	Calif. Hazelnut	1	40
Herbs & Grasses			
IRI	Iris sp.	1	73
PYPI	Whiteveined wintergreen	1	46
HIAL	White Hawkweed	1	46
PTAQL	Bracken Fern	2	40

Environment

Elevation: 4100-6300 ft.

Aspect: N.E.,S.

Slope: 0-67%

Slope Position: ridgetop & upper 1/3

Surface Rock: 0-10%

Soils

Pit Depth:18-40"+

Coarse Fragments: 10-62%

Textures: l, gl, vgl

Parent Material: sandstone

Distribution/Environment

The Jeffrey Pine-White Fir/Iris type was found on the Orleans, Happy Camp, Gasquet, Lower Trinity, Corning, and Upper Lake Ranger Districts. Mean distance to the Pacific Ocean was 31.4 miles in these upper one-third and ridgetop slope positions. Elevation averaged 5155 feet and ranged from 4100 to 6300 feet, highest of all Jeffrey pine plant associations. Slopes were moderately steep (29%), south, east, and north facing with high radiation index (.520) as a result aspect.

Soil Summary

Soils in this type were derived from coarse textured sandstone parent rocks. These rocks impart a moderately acidic surface pH of 6.0 and subsurface pH of 5.8, lowest in the Jeffrey pine series. Soils were well drained, moderately deep (51%), deep (36%) and shallow (13%), loams to very gravelly loams, with a high AWC (3.2"), thick A horizons (13"), and high A horizon coarse fragments (32%). They were found in the frigid soil temperature regime and were highly productive for conifer growth. The dominant soil families were loamy skeletal, mixed, frigid, Dystric Xerochrepts (57%) and loamy skeletal, mixed, frigid, Xerumbrepts (29%).

Vegetation

Total vegetation ranged from 65-99% with an average of 78%. Overstory cover of 71% was the highest of all Jeffrey pine plant associations. The dominant overstory species were Jeffrey pine (25%) and white fir (30%), with Douglas-fir (14%) as an occasional codominant. The regeneration layer included white fir (3%), incense cedar (3%), canyon live oak (4%), Douglas-fir (1%), and Jeffrey pine (1%). The high cover of white fir and low cover of Jeffrey pine in the regeneration layer is probably related to fire suppression. The shrub layer had the lowest average cover of all Jeffrey pine plant associations 2%. It included occasional occurrences of creeping snowberry (*Symphoricarpus mollis*) (1%), wood rose (2%), California hazelnut (*Corylus cornuta* var. *californica*) (2%), and Pacific serviceberry (2%). The forb layer was also the lowest in the Jeffrey pine series, with a mean cover of 3%. It often included iris (1%), white hawkweed (1%), white veined wintergreen (1%), braken fern (2%), and western prince's pine (2%). The grass layer was also sparse with occasional occurrences of western fescue (5%), bearded fescue (*Festuca subulata*) (1%), and blue wild-rye (*Elymus glaucus)* (1%).

Disturbance and Age Class Distribution

Stands found in this type ranged in age from 115 to 400 years with an average age of 274 years. The highest frequency of stands (47%) were found between 226 and 325 years of age. The frequency of stands above 300 years was 33% and the frequency of stands below 200 years was 27%. The relatively even distribution of stands by age class category indicates that stand replacing fires have occurred with regularity, particularly in the period between 1595 and 1880. Fire intensity between 1880 and 1995 appears to have been restricted to low intensity, non-stand replacing events.

Stand Structure Summary

This type had a moderately dense mixture of uneven-aged, tolerant and intolerant tree species, from a variety of diameter and age classes, which often resulted in multiple layers. The overstory was usually composed of at least three layers of different aged conifers. The top layer was dominated by Jeffrey pine, while the second and third layers included white fir as a codominant with Jeffrey pine. The top layer had an average height of 126 feet and diameter of 41 inches. The

second layer had an average height of 93 feet and diameter of 25 inches. The height and diameter of the third layer averaged 71 feet and 22 inches respectively.

Softwood cubic volume ranged from moderate to high values with an average of 11,377 $ft.^3$ which is well above the average for all types in the Jeffrey pine series (4,758 $ft.^3$). Basal area also ranged from moderate to high with an average of 306 $ft.^2$, this was also well above the average for the series of 169 $ft.^2$. Dunning site class was 2 with site index of 150 at 300 years. Stand density index was high with an average of 458, which is the highest of all types in the Jeffrey pine series.

Successional Trends

The Jeffrey Pine-White Fir/Iris type has a high potential for alteration of its successional pathway with continued fire suppression. Jeffrey pine is an intolerant species that requires an open canopy for successful regeneration. As we can see from the percent cover in the understory, third layer and second layer, white fir is replacing Jeffrey pine as the dominant species by shading it out.

Rare Plant Relationships

No sensitive or rare plants have been identified in this type to date.

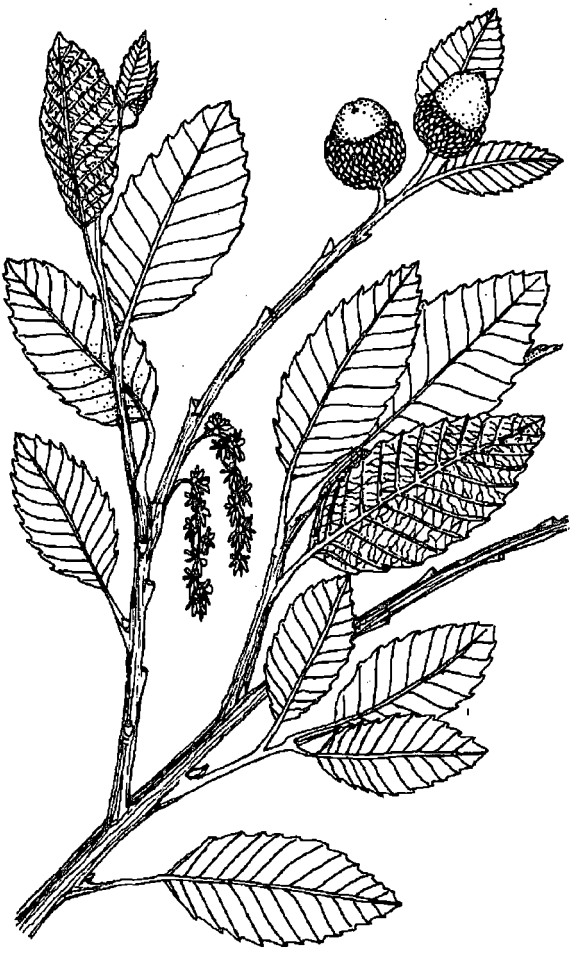
Management Implications

The Jeffrey Pine-White Fir/Iris type is highly productive, particularly when compared to the rest of the Jeffrey pine series. It does however, include several potential limitations to management. First, the selection of silviculture treatment technique must consider the high cover of white fir, particularly in the regeneration layer. Prescriptions that maintain heavy canopy cover will tend to favor white fir over Jeffrey pine and could substantially alter species composition. Second, the frigid soil temperature regime, coarse textured soils, with occasionally very high coarse fragments and steep slopes could affect regeneration success. Third, site preparation methods such as moderate to high intensity broadcast burns that lead to removal of the O horizon, could lead to soil erosion and gullying, particularly on steep slopes.

Closely Related Types

The Jeffrey Pine-White Fir/Iris type is often found downslope from the Jeffrey Pine-Incense Cedar/Siskiyou mat type. Site conditions in the Jeffrey Pine-Incense Cedar/Siskiyou mat type are much drier with shallower soils, lower AWC, and higher surface rock. Productivity is also significantly less than in the Jeffrey pine white fir/iris type.

Jeffrey Pine-White Fir/Sadler Oak/ Beargrass PIJE-ABCO/QUSA/XETE Association EcoCode CPJCFW12



Sadler oak
(Quercus sadleriana)

Jeffrey Pine-White Fir/Sadler Oak/Beargrass
PIJE-ABCO/QUSA/XETE Association, EcoCode CPJCFW12

SUMMARY TABLE

(Sample Size:7)		COVER	CON
Tree Overstory Layer			
PIJE	Jeffrey Pine	29	100
PSME	Douglas-Fir	9	100
PILA	Sugar Pine	12	85
ABCO	White Fir	11	57
CACH2	Chinquapin	26	57
Tree Understory Layer			
PSME	Douglas-Fir	1	100
PILA	Sugar Pine	3	100
ABCO	White Fir	3	71
PIJE	Jeffrey Pine	9	71
CACH2	Chinquapin	1	71
Shrubs			
QUSA	Sadler Oak	37	100
VAPA	Red Huckleberry	4	71
ARNE2	Pinemat Manzanita	34	57
GAOV	Slender Salal	4	57
Herbs & Grasses			
XETE	Beargrass	29	100
PYPID	Nootka Wintergreen	1	57
PTAQL	Bracken Fern	1	57

Environment

Elevation: 3280-4000 ft.

Aspect: N.E.,S.E.

Slope: 5-37%

Slope Position: ridgetop & upper 1/3

Surface Rock: 0-35%

Soils

Pit Depth: 33-37"

Coarse Fragments: 5-20%

Textures: gl, l

Parent Material: siltstone, peridotite, schist

Distribution/Environment

The Jeffrey Pine-White Fir/Sadler Oak/Beargrass type appears to be restricted to the Orleans Ranger District. Mean distance to the Pacific Ocean was 18.5 miles with frequent coastal fog contributing to a cool/moist environment in these upper one-third and flattened bench slope positions. Elevation averaged 3746 feet and ranged from 3280 to 4000 feet, this fell in the middle elevation range of all Jeffrey pine plant associations. Slopes were gentle (19%), east, south, and west facing, and moderated by topographic shading. Radiation index was the lowest of all Jeffrey pine plant associations (.470).

Soil Summary

Soils in this type were derived from peridotite, schist or siltstone parent rocks. This mixture of parent materials resulted in slightly acidic surface pH of 6.3 and subsurface pH of 6.2. Soils were well drained (100%), moderately deep (100%), loams to gravelly loams, with moderately high AWC (2.6"), moderately thick A horizons (6"), and low A horizon coarse fragments (16%). They were found in the frigid soil temperature regime and were moderately productive for conifer growth. The dominant soil families were fine loamy, mixed, frigid, dystric xerochrepts (50%) and fine loamy, mixed, frigid, Ultic Haploxeralfs (50%).

Vegetation

Total vegetation ranged from 90-99% with an average of 97%, the highest in the Jeffrey pine series. Overstory cover of 66% was the second highest of all Jeffrey pine plant associations. The dominant overstory species were Jeffrey pine (29%), with sugar pine (12%), white fir (11%), and Douglas-fir (9%) as codominants. Chinquapin was the lone hardwood occasionally found in this type, when present it had high cover (26%). The regeneration layer included Jeffrey pine (9%) as the dominant species, with sugar pine (3%), Douglas-fir (1%), white fir (3%), and chinquapin (1%). The shrub layer had the second highest average cover of all Jeffrey pine plant associations 55%. It was dominated by Sadler oak (37%), with pinemat manzanita (34%), and red huckleberry (4%) as an associate species. The forb layer was the highest in the Jeffrey pine series, with a mean cover of 30%. It was dominated by beargrass (29%) and often included iris (1%), western prince's pine (1%), nootka wintergreen (*Pyrola picta* ssp. *dentata*) (1%), braken fern (1%), California false hellebore (*Veratrum californicum)* (1%), and spreading dogbane (*Apocynum androsaemifolium*) (1%). The grass layer was lacking in this type.

Disturbance and Age Class Distribution

Stands found in this type ranged in age from 71 to 526 years with an average age of 378 years, oldest in the Jeffrey pine series. This is probably due to the low frequency of stand replacing fires occurring on these cool/moist upland sites, and the influence of coastal fog due to their close proximity to the Pacific Ocean. The highest frequency of stands (43%) were found in age classes between 276 and 375 years and greater than 475 years of age (43%). The frequency of stands above 300 years was 79% and the frequency of stands below 200 years was 14%. This indicates the low frequency of stand replacing fires that occur in this type, particularly in the last 300 years.

Stand Structure Summary

This type had a moderately dense mixture of uneven-aged, moderately tolerant and intolerant tree species, from a variety of diameter and age classes. The overstory is usually composed of at least three layers of different aged conifers, all three layers were dominated by Jeffrey pine with sugar pine as a codominant.

The top layer had an average height of 141 feet, tallest in the Jeffrey pine series and diameter of 40 inches. The second layer had an average height of 112 feet and diameter of 29 inches. The height and diameter of the third layer averaged 65 feet and 15 inches respectively.

Softwood cubic volume ranged from low to moderate with an average of 5,170 $ft.^3$ which is slightly above the average for all types in the Jeffrey pine series (4,758 $ft.^3$). Basal area also ranged from low to moderate with an average of 170 $ft.^2$, this compared to the average for the series of 169 $ft.^2$. Dunning site class was 3 with site index of 125 at 300 years. Stand density index was moderate with an average of 350, which is among the highest of all types in the Jeffrey pine series.

Successional Trends

The Jeffrey Pine-White Fir/Sadler Oak/Beargrass type has a low potential for alteration of its successional pathway with continued fire suppression. The mostly serpentine soils combined with occasional low intensity ground fires appear to be suppressing white fir and allowing both Jeffrey pine and sugar pine to successfully reproduce.

Rare Plant Relationships

No sensitive or rare plants have been identified in this type to date.

Management Implications

The Jeffrey Pine-White Fir/Sadler Oak/Beargrass type is moderately productive when compared to the rest of the series. It does however, include potential limitations to management. The selection of silviculture treatment technique must consider the high cover of shrubs and forbs such as beargrass, along with the frigid soil temperature regime as potential limitations to successful regeneration. Treatments such as individual tree and group selection are particularly well suited for this type. Site preparation techniques such as broadcast burning should be avoided as they tend to stimulate beargrass and can affect regeneration.

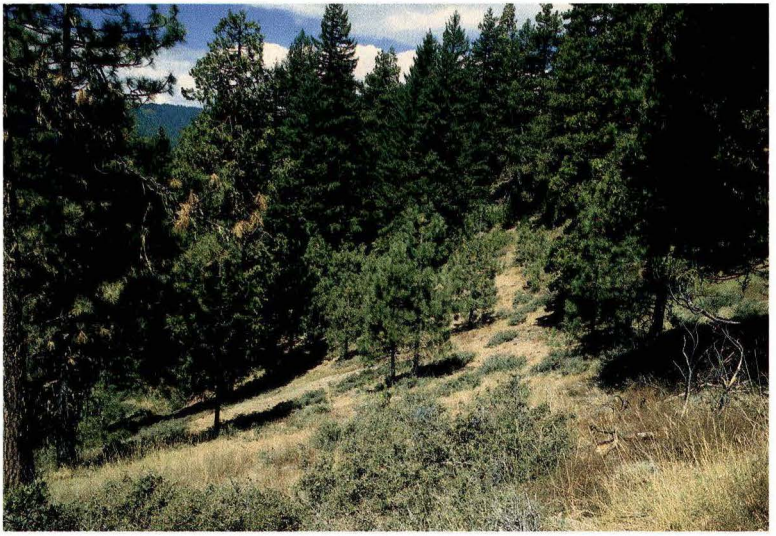
Closely Related Types

The Port-Orford cedar/Western Azalea type was often found in wet streamside areas adjacent to the Jeffrey Pine-White Fir/Sadler Oak/Beargrass type.

Jeffrey Pine-Incense Cedar/Buck Brush
PIJE-CADE3/CECU-2 Association
EcoCode CPJCCI14

buck brush
(Ceanothus cuneatus)

Jeffrey Pine-Incense Cedar/Buck Brush PIJE-CADE3/CECU2 Association, EcoCode CPJCCI14



SUMMARY TABLE

(Sample Size:20)		COVER	CON
Tree Overstory Layer			
PIJE	Jeffrey Pine	20	100
CADE3	Incense Cedar	10	81
PSME	Douglas-Fir	6	75
Tree Understory Layer			
PIJE	Jeffrey Pine	1	95
CADE3	Incense Cedar	2	75
PSME	Douglas-Fir	1	60
Shrubs			
CECU2	Buckbrush	24	95
ARPA9	Greenleaf Manzanita	5	45
RHDI	Poison Oak	3	30
RHCA	Coffeeberry	3	25
Herbs & Grasses			
FEID	Idaho Fescue	15	55
HIAL	White Hawkweed	1	50
FECA	California Fescue	11	40
CATO	Tolmie's Star Tulip	1	20

Environment

Elevation: 920-6000 ft.

Aspect: N.E.,S.

Slope: 10-55%

Slope Position: middle, upper 1/3, & ridge top

Surface Rock: 1-25%

Soils

Pit Depth:15-40"+

Coarse Fragments:10-50%

Textures: gl, sl

Parent Material: serpentine, ultramafic

Distribution/Environment

The Jeffrey Pine-Incense Cedar/Buckbrush type was found on the Lower Trinity, Mad River, Orleans and Corning Ranger Districts. Mean distance to the Pacific Ocean was 31.5 miles, among the highest of all Jeffrey pine types. This type was found on exposed noses of spur ridges in the middle and upper one-third slope positions, with high surface rock (17%) and bare ground (5%). Elevation averaged 3467 feet and ranged from 920 to 6000 feet, the widest range in the Jeffrey pine series. Slopes were moderate (33%), southeast and northeast facing with high radiation index (.510).

Soil Summary

Soils in this type were derived from serpentinite and peridotite parent rocks and had neutral surface and subsurface pH's of 6.9 and 7.0. Soils were well drained (62%), moderately well drained (23%), and somewhat excessively drained (15%), shallow (7%), moderately deep (55%), and deep (38%), gravelly loams and sandy loams, with a moderate mean AWC (2.4"), thick A horizons (9"), and low A horizon coarse fragments (22%). They were found in the mesic and frigid soil temperature regimes and were of very low productivity for conifer growth. The dominant soil families were loamy skeletal, serpentinitic, mesic, Typic, Xerochrepts (62%) and fine loamy, serpentinitic, mesic, Typic, Argixerolls (25%).

Vegetation

Total vegetation cover was moderate and ranged from 42-95%, with an average of 70%. Overstory cover of 33% was among the lowest of all Jeffrey pine plant associations. The dominant overstory species was Jeffrey pine (20%), with incense cedar (10%), and Douglas-fir (6%) as codominant species. The regeneration layer included mainly Jeffrey pine (1%), incense cedar (2%), and Douglas-fir (1%). The shrub layer had a moderate mean cover, 29%. It was dominated by buckbrush (24%), with greenleaf manzanita (5%), and coffeeberry (3%) as occasional associates. The forb layer had a moderately mean cover of 7%. It included a variety of species of low cover, including white hawkweed (1%), Tolmie's star tulip (1%), fawn lily (*Erythonium* sp.) (1%), buttercup (1%), and buckwheat (*Eriogonum* sp.) (3%). Cover in the grass layer was among the highest in the Jeffrey pine series. It averaged 27% and included a variety of species such as California fescue (11%) and Idaho fescue (15%).

Disturbance and Age Class Distribution

Stands found in this type had their age class distribution dominated by stands in younger age classes. They ranged in age from 101-403 years with an average age of 203 years, second youngest in the Jeffrey pine series. The highest frequency of stands (38%) were found in stands below 126 years of age. The frequency of stands above 300 years was 23% and the frequency of stands below 200 years was 54%. This dominance of stands in younger age classes indicates that stand replacing fires have occurred frequently, particularly during the last 200 years. This was probably due to the high cover of shrubs and grasses which would add ladder fuels and contribute to high intensity fires of stand replacing nature.

Stand Structure Summary

This type had an open layer of stunted, often flat topped trees over a moderate shrub and grass layer. The tree layer is a mixture of uneven-aged, intolerant and moderately intolerant tree species. They include a variety of diameter and age classes, resulting in multiple layers. There usually are at least three layers of different aged conifers present. All layers were dominated by Jeffrey pine with incense cedar as a codominant or associate species. The top layer had an average height of 108 feet and diameter of 31 inches. The second layer had an

average height of 76 feet and diameter of 25 inches, while the third layer averaged 44 feet in height and 13 inches in diameter.

Softwood cubic volume ranged from very low to high values with an average of 4378 $ft.^3$ which is just below the average for all types in the Jeffrey pine series (4,758 $ft.^3$). Basal area ranged from very low to moderate with an average of 172 ft^2, this was just at the average for the series, 169 $ft.^2$. Dunning site class was 2 or 4 with a site index of 150 or 100 at 300 years. Stand density index was among the middle group in the series with an average of 294.

Successional Trends

The Jeffrey Pine-Incense Cedar/Buckbrush type has a moderate potential for alteration of its successional pathway with continued fire suppression. This is due to the presence of the tolerant species, white fir on higher elevation sites. Low intensity fires in this type would tend to discourage white fir regeneration and favor Jeffrey pine. Unfortunately, the current situation in these stands, dense shrub and grass cover could lead to stand replacing fires.

Rare Plant Relationships

No rare or sensitive plants have been identified in this type to date.

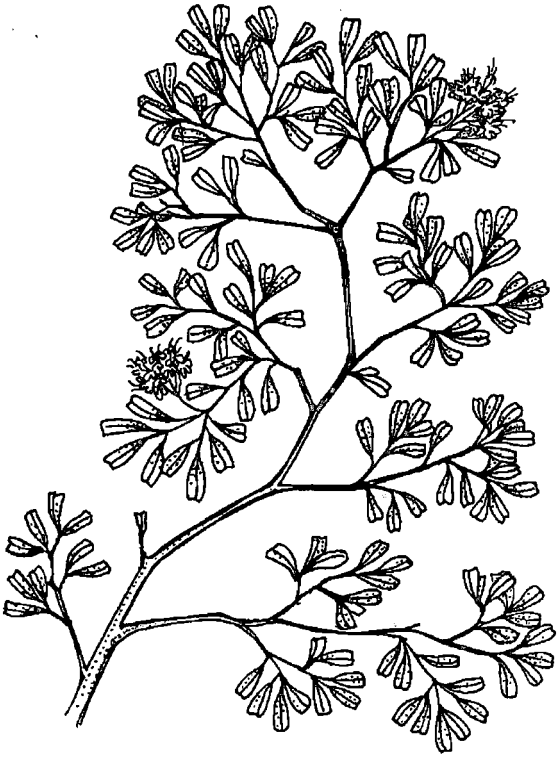
Management Implications

The Jeffrey Pine-Incense Cedar/Buckbrush type provides browse for deer and cover on these harsh, frequently disturbed ridgetop sites. Due to the high frequency of disturbance that occurs naturally on these sites, they are better left unmanaged.

Closely Related Types

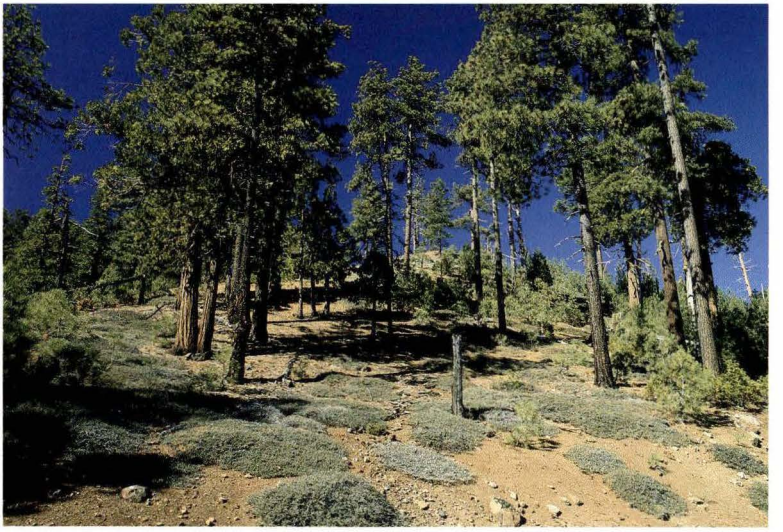
The Jeffrey Pine-Incense Cedar/Buckbrush type was found to intergrade with the Douglas-fir-California Bay/Poison Oak type on lower elevation sites. These types differ in slope position, with the Jeffrey Pine-Incense Cedar/Buckbrush type found on convex shaped spur ridges, while the Douglas-fir-California Bay/Poison Oak type was found in concave draws just downslope. Other types found in close proximity include the Douglas-fir-Incense Cedar/California Fescue and Douglas-fir-Jeffrey Pine/California Fescue types. Both of these types were found downslope from the Jeffrey Pine-Incense Cedar/Buckbrush type in areas of greater soil accumulation and development.

Jeffrey Pine-Incense Cedar/ Siskiyou Mat
PIJE-CADE3/CEPU1 Association
EcoCode CPJCCI13



Siskiyou mat
(Ceanothus pumilus)

Jeffrey Pine-Incense Cedar/Siskiyou Mat PIJE-CADE3/CEPU1 Association, EcoCode CPJCCI13



SUMMARY TABLE

(Sample Size:11)		COVER	CON
Tree Overstory Layer			
PIJE	Jeffrey Pine	25	100
CADE3	Incense Cedar	10	81
PSME	Douglas-Fir	18	27
Tree Understory Layer			
PIJE	Jeffrey Pine	6	100
CADE3	Incense Cedar	4	100
PSME	Douglas-Fir	3	27
Shrubs			
CEPU1	Siskiyou Mat	29	100
ARC-5	Manzanita sp.	3	27
Herbs & Grasses			
HIAL	White Hawkweed	6	45
PYPI	White veined wintergreen	1	36
IRI	Iris sp.	1	27
GAAM	Bedstraw	1	18

Environment

Elevation: 4560-5340 ft.

Aspect: S.W.,N.W.

Slope: 0-40%

Slope Position: upper 1/3

Surface Rock: 1-70%

Soils

Pit Depth: 4-40"+

Coarse Fragments:10-50%

Textures: gl, l

Parent Material: serpentine, ultramafic

Distribution/Environment

The Jeffrey Pine-Incense Cedar/Siskiyou mat type was found on the Mad River and Gasquet Ranger Districts. Mean distance to the Pacific Ocean was 36.8 miles, highest of all Jeffrey pine plant associations. This type was found on the noses of spur ridges in the upper one-third slope positions, with high surface rock (17%) and bare ground (3%). Elevation averaged 5022 feet, second highest in the series and ranged from 4560 to 5340 feet. Slopes were moderate (25%), southwest and south facing, with high radiation index (.500).

Soil Summary

Soils in this type were poorly developed, derived from serpentinite and peridotite parent rocks, and had neutral surface pH (7.2) and slightly alkaline subsurface pH (7.5). Soils were well drained (73%), moderately well drained (18%), and somewhat excessively drained (9%), shallow (45%), moderately deep (37%), and deep (18%), loams and gravelly loams, with a moderately low mean AWC (2.0"), thin A horizons (4"), and moderate A horizon coarse fragments (23%). They were found mainly in the frigid soil temperature regime and were of very low productivity for conifer growth. The dominant soil families were fine loamy, serpentinitic, frigid, Lithic or Dystric, Xerochrepts (50%), loamy skeletal, serpentinitic, frigid, Lithic, Xerorthents (17%), and loamy skeletal, serpentinitic, frigid, Typic Haploxeralfs (17%).

Vegetation

Total vegetation cover was the second lowest in the Jeffrey pine series as a result of a harsh environment with high surface rock and bare ground. Total cover ranged from 40-80%, with an average of 64%. Overstory cover of 43% was the among the lowest of all Jeffrey pine plant associations. The dominant overstory species was Jeffrey pine (25%), with incense cedar (10%) as a codominant species. The regeneration layer included mainly Jeffrey pine (6%) and incense cedar (4%). The shrub layer had a moderately high mean cover (34%). It was dominated by Siskiyou mat (29%), with various manzanita species (3%). The forb layer had a moderately mean cover of 9%. It included a variety of species of low cover including iris (1%), white hawkweed (6%), bedstraw (1%), and white veined wintergreen (1%). Cover in the grass layer was generally lacking, it averaged 3%.

Disturbance and Age Class Distribution

Stands found in this type had their age class distribution dominated by older age classes. They ranged in age from 238-500 years with an average age of 334 years, second oldest in the Jeffrey pine series. The highest frequency of stands (54%) were found in stands between 226-325 years of age. The frequency of stands above 300 years was 73% and the frequency of stands below 200 years was 0%. This dominance of stands in older age classes indicates that stand replacing fires have occurred infrequently, with none evident during the last 200 years. This was probably due to the open overstory, low cover of shrubs, high amount of surface rock and bare ground which would tend toward fires of low intensity.

Stand Structure Summary

This type had an open layer of stunted, often flat topped trees over a moderate shrub layer. The tree layer is a mixture of uneven-aged, intolerant and moderately intolerant tree speices. They include a variety of diameter and age classes, resulting in multiple layers. There usually are two different aged conifers present. All layers were dominated by Jeffrey pine with incense cedar as a codominant or associate species. The top layer had an average height of 70 feet and diameter of 28 inches. The second layer had an average height of 56 feet and diameter of 21 inches.

Softwood cubic volume ranged from very low to low with and average of 1935 $ft.^3$ which is less than half the average for all types in the Jeffrey pine series (4758 $ft.^3$). Basal area ranged from very low to moderate with an average of 97 $ft.^2$, this was also well below the average for the series of 169 ft^2. Dunning site class was 5 with a site index of 75 at 300 years. Stand density index was among the lowest in the series with an average of 145.

Successional Trends

The Jeffrey pine-Incense Cedar/Siskiyou mat thpe has a low potential for alteration of its successional pathway with continued fire suppression. This is due to the open canopy that favors the mixture of intolerant and moderately tolerant tree species found here. Fires in this type are likely to burn at low intensity due to the pathchy nature of these stands, the lack of a significant shrub layer, and the high amount of surface rock.

Rare Plant Relationships

The sensitive plant, Lassics sandwort was identified in this type along with the rare plant Hoffman's onion.

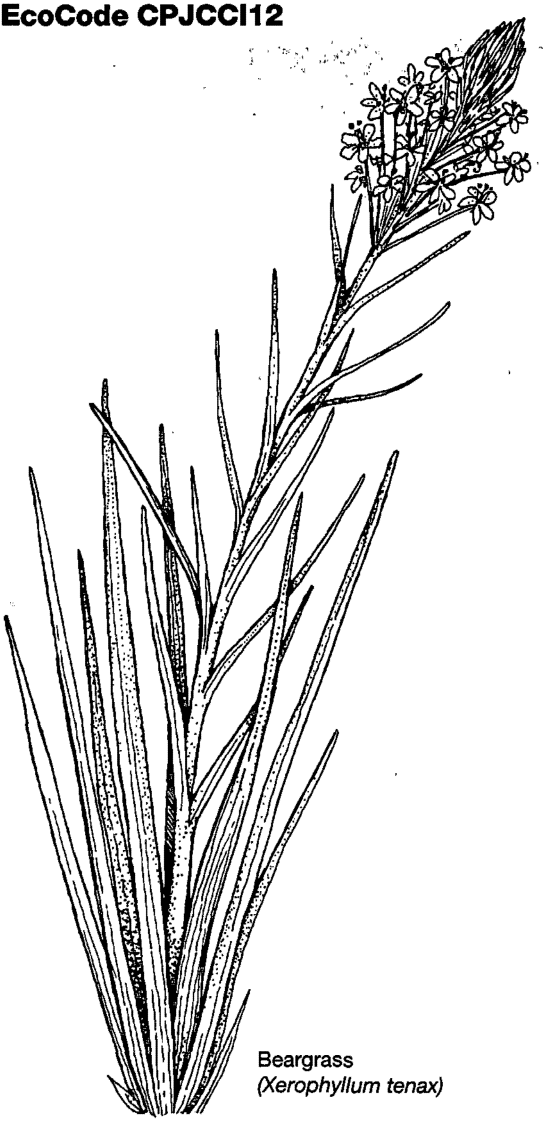
Management Implications

The Jeffrey pine-Incense Cedar/Siskiyou mat type provides open stands, usually in upslope positions that provide high elevation vistas of the surrounding environment. The harsh environments on these fragile sites limits options available for management treatments.

Closely Related Types

The Jeffrey Pine-White Fir/Iris type is found downslope from the Jeffrey Pine-Incense Cedar/Siskiyou mat type on soils derived from sandstone parent rock with higher soil accumulation and development. Productivity and stand structure were significantly different between the two, with the Jeffrey Pine-White Fir/Iris type having the highest productivity in the Jeffrey Pine series, while the Jeffrey Pine-Incense Cedar/Siskiyou mat type was among the lowest in productivity.

Jeffrey Pine/Incense Cedar/
Huckleberry Oak/Beargrass
PIJE-CADE3/QUVA/XETE Association
EcoCode CPJCCI12



Beargrass
(Xerophyllum tenax)

Jeffrey Pine-Incense Cedar/Huckleberry Oak/ Beargrass
PIJE-CADE3/QUVA/XETE Association, EcoCode CPJCCI12

SUMMARY TABLE

(Sample Size:27)		COVER	CON
Tree Overstory Layer			
PIJE	Jeffrey Pine	17	100
CADE3	Incense cedar	8	92
PSME	Douglas- Fir	6	81
PILA	Sugar Pine	12	70
Tree Understory Layer			
PIJE	Jeffrey Pine	1	92
CADE3	Incense Cedar	1	85
PSME	Douglas-Fir	1	66
PILA	Sugar Pine	2	55
Shrubs			
QUVA	Huckleberry Oak	52	100
ARNE2	Pinemat Manzanita	9	72
ARPA9	Greenleaf Manzanita	3	59
RHCA2	Coffeeberry	1	62
Herbs & Grasses			
XETE	Beargrass	9	81
LIBO2	Bolander's Lily	1	33
WHMO	Western modesty	1	25

Environment

Elevation: 2600-4800 ft.

Aspect: N.,S.E.,S.W.,N.W.

Slope: 0-55%

Slope Position: ridgetop, upper & middle 1/3

Surface Rock: 1-80%

Soils

Pit Depth: 16-40"+

Coarse Fragments: 15-70%

Textures: gl, vgl, vgcl

Parent Material: serpentinite, peridotite

Distribution/Environment

The Jeffrey Pine-Incense Cedar/Huckleberry Oak/Beargrass type was found on the Orleans, Lower Trinity, and Happy Camp Ranger Districts. Mean distance to the Pacific Ocean was 20.9 miles in these ridgetop and upper one-third slope positions. Elevation averaged 4148 feet and ranged from 2600 to 4800 feet, it was included among the upper middle elevation group in the Jeffrey pine series. Slopes were moderate (30%), south and southeast facing, with high radiation index (.490).

Soil Summary

Soils in this type were derived from serpentinite and peridotite parent rocks, with slightly acid surface pH of 6.4 and neutral subsurface pH of 6.9. Soils were well drained (79%) and somewhat excessively drained (21%), shallow (21%), moderately deep (72%), and deep (7%), gravelly and very gravelly loams, with a low mean AWC (1.8"), thin A horizons (5"), and high A horizon coarse fragments (40%). They were found mainly in the frigid soil temperature regime and were of low productivity for conifer growth. The dominant soil families were loamy skeletal, mixed, frigid, typic or Dystric, xerochrepts (79%) and fine loamy, mixed, mesic, Ultic, Haploxeralfs (21%).

Vegetation

Total vegetation cover was high, it ranged from 60-99%, with an average of 76%. Overstory cover of 37% was the among the lowest of all Jeffrey pine plant associations. The dominant overstory species was Jeffrey pine (17%), with sugar pine (12%) as a codominant species and frequent low cover occurrences of incense cedar (8%) and Douglas-fir (6%). The regeneration layer included Jeffrey pine (1%), sugar pine (2%), incense cedar (1%), and Douglas-fir (1%). The shrub layer had the highest mean cover (60%) of all types in the Jeffrey Pine series. It was dominated by huckleberry oak (52%), with pinemat manzanita (9%), and frequent occurrences of Pacific serviceberry (1%), coffeeberry (1%), squawcarpet (3%), greenleaf manzanita (3%), creeping Oregon grape (1%), dwarf silktassel (3%), and red huckleberry (7%). The forb layer had a moderately mean cover of 9%. It was dominated by beargrass (8%), and often included western modesty (1%) and Bolander's lily (1%). Cover in the grass layer was lacking but when present included various sedge species.

Disturbance and Age Class Distribution

Stands found in this type had there age class distribution dominated by stands in younger age classes. They ranged in age from 91 to 609 years with an average age of 231 years, among the youngest in the Jefrrey pine series. The highest frequency of stands (55%) were found in stands below 176 years of age. The frequency of stands above 300 years was 22% and the frequency of stands below 200 years was 61%. This dominance of stands in younger age classes indicates that stand replacing fires have occurred frequently during the last 200 years, with a high frequency in the period between 1820 and 1904. This was probably due to the high cover of shrubs, which would tend toward fires of stand replacing intensity.

Stand Structure Summary

This type had an open layer of stunted, often flat topped trees over a dense shrub layer. The tree layer is a mixture of uneven-aged, intolerant and moderately intolerant tree species. They include a variety of diameter and age classes, resulting in multiple layers. There usually are at least three layers of different aged conifers present, although often hard to discern. All layers were dominated by Jeffrey pine with Douglas-fir, sugar pine, and incense cedar as codominants or associate species. The top layer had an average height of 77 feet and diameter of 25 inches. The second layer had an average height of 52 feet and diameter of 16 inches. The height and diameter of the third layer averaged 39 feet and 11 inches

respectively.

Softwood cubic volume ranged from very low to low values with an average of 2941 $ft.^3$ which is well below the average for all types in the Jeffrey pine series (4,758 $ft.^3$). Basal area ranged from low to moderate with an average of 118 $ft.^2$, this was also well below the average for the series of 169 $ft.^2$. Dunning site class ranged from 4 to 5 with a mode of 5, site index was 75 at 300 years. Stand density index was among the lowest in the series with an average of 192.

Successional Trends

The Jeffrey Pine-Incense Cedar-White Fir/Huckleberry Oak type has a low potential for alteration of its successional pathway with continued fire suppression. This is due to the open canopy that favors the mixture of intolerant and moderately tolerant tree species found here. Examples of the effects of wildfire in this type indicate that the high amounts of ladder fuels present, particularly in the shrub layer, can lead to hot fires with high intensity that consume most or all of the organic material present and lead to a rock dominated, bare landscape. Because of the harsh site conditions caused by these burns, recovery towards pre-burn conditions will likely be very slow.

Rare Plant Relationships

Two sensitive and six rare plants were indentified in the Jeffrey Pine-Incense Cedar/Huckleberry Oak/Beargrass type. The sensitive plants, pale yellow stonecrop and Sonoma manzanita were found in this type. The rare plants included, evergreen everlasting, Washington lily, Bolander's lily, Howell's lomatium, Peck's sanicle, and serpentine arnica.

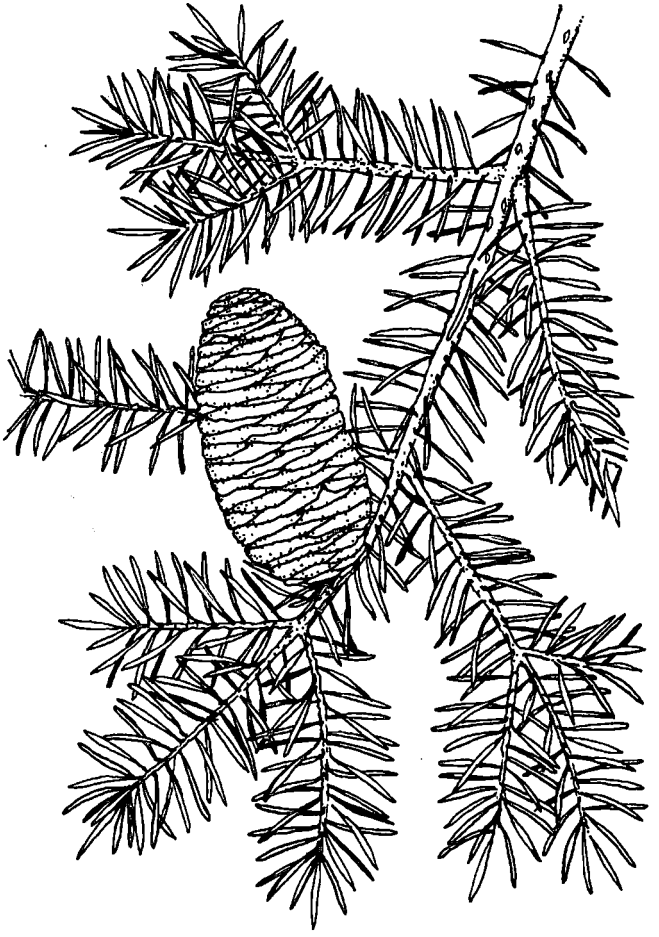
Management Implications

The Jeffrey Pine-Incense Cedar/Huckleberry Oak/Beargrass type provides high cover of shrubs on harsh sites, as well as rare plant habitat. Management treatments. particularly prescribed burning aimed at maintaining species composition must consider the real possibility of losing these features due to high potential for stand replacing fires. If treatment is required spring burns are suggested. The effect of fire on rare plants needs further study.

Closely Related Types

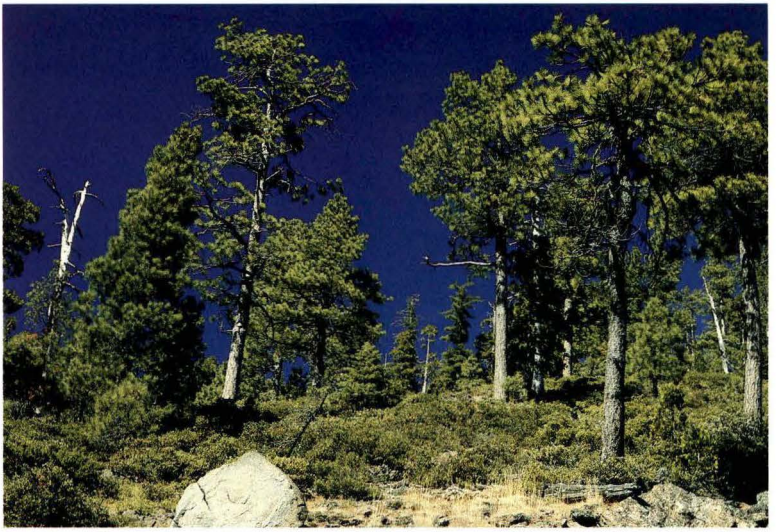
The Jeffrey Pine-Incense Cedar/Huckleberry Oak/Beargrass type is closely related to the Jeffrey Pine-Incense Cedar-White Fir/Huckleberry Oak type. Site conditions are much better in the latter type leading to higher productivity. The Douglas-fir/Huckleberry Oak type has also been found to occur in close proximity to the Jeffrey Pine-Incense Cedar/Huckleberry Oak/Beargrass type. It was found downslope, in areas with higher soil accumulation and slightly higher productivity. In contrast, the Jeffrey Pine/Huckleberry Oak-Pinemat Manzanita/Idaho fescue type is found upslope in ridgetop positions, where site conditions are harsher and productivity is substantially lower.

Jeffrey Pine-Incense Cedar-White Fir/ Huckleberry Oak PIJE-CADE3-ABCO/QUVA Association EcoCode CPJCCl11



white fir
(Abies concolor)

Jeffrey Pine-Incense Cedar-White fir/Huckleberry Oak
PIJE-CADE3-ABCO/QUVA Association, EcoCode CPJCCI11



SUMMARY TABLE

(Sample Size:17)		COVER	CON
Tree Overstory Layer			
PIJE	Jeffrey Pine	23	100
CADE3	Incense Cedar	14	100
PSME	Douglas-Fir	17	76
Tree Understory Layer			
ABCO	White Fir	2	88
CADE3	Incense Cedar	2	82
PIJE	Jeffrey Pine	2	64
PILA	Sugar Pine	1	52
PSME	Douglas-Fir	1	47
Shrubs			
QUVA	Huckleberry Oak	43	94
ARNE2	Pinemat Manzanita	12	58
AMAL	Pacific Serviceberry	2	58
GABU2	Dwarf Silktassel	2	41
ARPA9	Greenleaf Manzanita	3	35
Herbs & Grasses			
XETE	Beargrass	12	76
CHUMO	Western prince's pine	1	70
GOOB	Rattlesnake Plantain	1	47
PYPID	Nootka Wintergreen	1	41

Environment

Elevation: 2600-5180 ft.

Aspect: S.E., S.W., N.W.

Slope: 5-50%

Slope Position: ridgetop, upper , middle & lower 1/3

Surface Rock: 1-30%

Soils

Pit Depth: 11-40"+

Coarse Fragments: 7-62%

Textures: gl,vgl, vgcl

Parent Material: serpentinite, peridotite

Distribution/Environment

The Jeffrey Pine-Incense Cedar-White Fir/Huckleberry Oak type was found on the Lower Trinity, Happy Camp, Salmon River, Ukonom, and Gasquet Ranger Districts. Mean distance to the Pacific Ocean was 30.8 miles in these ridgetop and upper one-third slope positions. Elevation averaged 4522 feet and ranged from 2670 to 5180 feet, among the highest in the Jeffrey pine series. Slopes were moderate (27%), west and southeast facing with high radiation index (.480).

Soil Summary

Soils in this type were derived from serpentinite and peridotite parent rocks, resulting in slightly acid surface pH (6.4) and neutral subsurface pH (6.7). Soils were well drained (86%) and somewhat excessively drained (14%), shallow (36%), moderately deep (50%), and deep (14%), gravelly loams, very gravelly loams, and very gravelly clay loams, with a moderate mean AWC (2.1"), moderate A horizons (5"), and moderate A horizon coarse fragments (32%). They were found mainly in the frigid soil temperature regime and were of moderate productivity for conifer growth. The dominant soil families were loamy skeletal serpentinitic, frigid, Typic, Xerochrepts (57%) and loamy skeletal, mixed, frigid, Lithic, Xerochrepts (36%).

Vegetation

Total vegetation ranged from 35-99%, with an average of 86%. Overstory cover of 59% was among the highest of all Jeffrey pine plant associations. The dominant overstory species was Jeffrey pine (23%), with incense cedar (14%) as a codominant species, and Douglas-fir (17%), white fir (8%), and sugar pine (7%) as frequent associates. The regeneration layer was dominated by white fir (2%), with incense cedar (2%), Jeffrey pine (2%), sugar pine (1%), and Douglas-fir (1%) as frequent associates. The shrub layer was dense in cover, it had the third highest mean average cover (52%) of all Jeffrey pine plant associations. It was dominated by huckleberry oak (43%), with pinemat manzanita (11%), and occasional occurrences of Pacific serviceberry (2%), and dwarf silktassel (2%). The forb layer had a moderately high mean cover of 12%. It often included high cover of beargrass (12%), with nootka wintergreen (1%), western prince's pine (1%), and rattlesnake plantain (1%). Cover in the grass layer was lacking in this type.

Disturbance and Age Class Distribution

Stands found in this type had their age class distribution dispersed through all age classes. They ranged in age from 116 to 667 years with an average age of 315 years, third oldest in the Jeffrey pine series. The highest frequency of stands (54%) were found in stands 226 and 375 years of age. The frequency of stands above 300 years was 53% and the frequency of stands below 200 years was 18%. This dominance of stands in older age classes indicates that stand replacing fires have occurred infrequently during the last 200 years, with a higher frequency in the period between 1620 and 1770. Due to the high cover of shrubs, fires in this type would tend to be stand replacing in intensity.

Stand Structure Summary

This type had a relatively dense layer of trees over a dense shrub layer. The tree layer is a mixture of uneven-aged, intolerant and tolerant tree species, from a variety of diameter and age classes, which resulted in multiple layers. There usually are at least three layers of different aged conifers present. All layers were dominated by Jeffrey pine with Douglas-fir, sugar pine, and incense cedar as codominants or associate species. The top layer had an average height of 95 feet and diameter of 29 inches. The second layer had an average height of 76 feet and diameter of 23 inches. The height and diameter of the third layer averaged 51 feet

and 17 inches respectively.

Softwood cubic volume ranged from low to high values with an average of 6601 $ft.^3$ which is above the average for all types in the Jeffrey pine series (4,758 $ft.^3$). Basal area ranged from moderate to high with an average of 252 $ft.^2$, this was also well above the average for the series of 169 $ft.^2$. Dunning site class ranged from 3 to 5 with a mode of 5, site index was 75 at 300 years. Stand density index was second highest in the series with an average of 394.

Successional Trends

The Jeffrey Pine-Incense Cedar-White Fir/ Huckleberry Oak type has a moderate potential for alteration of its successional pathway with continued fire suppression. Successful invasion of white fir in the regeneration layer presents a potential shift toward more tolerant species in these dense stands. This shift is probably due to the absence of fire in the last 5 decades. Examples of the effects of wildfire in this type indicate that the high amounts of ladder fuels present can literally burn them back to a rock dominated, bare landscape. Because of the harsh site conditions caused by these burns, recovery towards pre-burn conditions will likely be very slow.

Rare Plant Relationships

The rare plant, Washington lily was identified in the Jeffrey Pine-Incense Cedar-White Fir/Huckleberry Oak type.

Management Implications

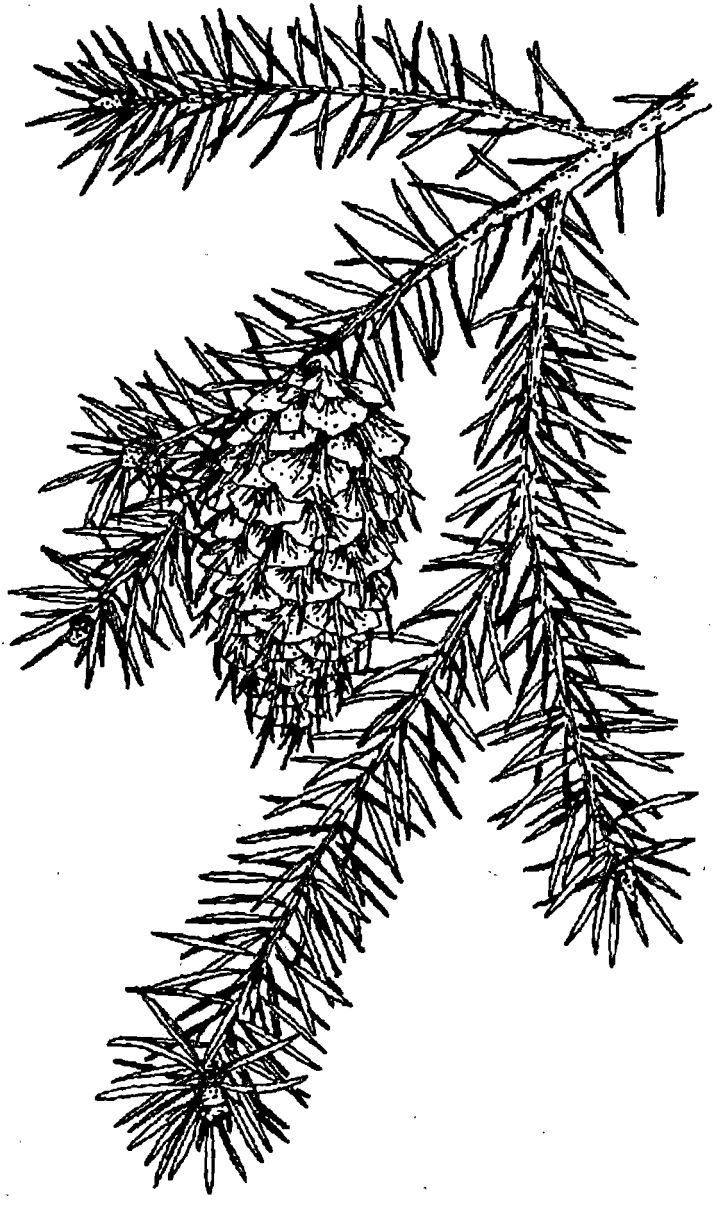
The Jeffrey Pine-Incense Cedar-White Fir/Huckleberry Oak type provides high cover of trees and shrubs on harsh sites, as well as rare plant habitat. It contributes stand structure diversity to environments that are often lacking these attributes. Management treatments, particularly broadcast burning aimed at maintaining species composition and structure attributes must consider the real possibility of losing these features due to high potential for stand replacing fires. If treatment is required, cool spring burns, jackpot burning, or pile burning are suggested.

Closely Related Types

The Jeffrey Pine-Incense Cedar-White Fir/Huckleberry Oak type is closely related to the Jeffrey Pine-Incense Cedar/Huckleberry Oak/Beargrass type. They differ in the significantly higher productivity in the Jeffrey Pine-Incense Cedar-White Fir/ Huckleberry Oak type. These differences include significantly higher softwood cubic volume, softwood basal area, and stand density index. Other differences between these two types include higher surface rock, lower AWC, and higher A horizon coarse fragments in the Jeffrey Pine-Incense Cedar/Huckleberry Oak/ Beargrass type.

The Jeffrey Pine/Huckleberry Oak-Pinemat Manzanita/Idaho Fescue type was found upslope from the Jeffrey Pine-Incense Cedar-White Fir/Huckleberry Oak type on exposed spur ridges.

Douglas-fir Series



INTRODUCTION TO THE DOUGLAS-FIR SERIES

The plant associations in the Douglas-fir series were described using 78 ecology plots. These plots were distributed from Del Norte County near the Oregon border to Last Chance Ridge in Humboldt County and extended from approximately 18 miles from the Pacific Ocean to a few miles east of Happy Camp in Siskiyou County. The highest frequency of plots were sampled in Humboldt and Siskiyou County. A large number of plots were also sampled in Del Norte County.

Three subseries and seven plant associations were described from the analysis of these plots (Table 6). The highest number of plant associations were found on the Orleans ranger district (7) followed by the Gasquet Ranger District (6). Three plant associations were found on the Ukonom Ranger District and two on the Lower Trinity Ranger District.

These plant associations are distinguished both by differences in species composition and environment. Some of the differences in species composition can be related to environmental variables directly, others cannot. The environmental variables that were significantly different among these plant associations were; distance from the Pacific Ocean, elevation, vertical microrelief, percent surface rock, percent volume of subsurface coarse fragments, and available water holding capacity. These associations were also significantly different for the vegetation variables; total tree cover, total grass cover, and total shrub cover. These associations also differed in percent cover of individual species such as Douglas-fir, California bay, Jeffrey pine, huckleberry oak, and pacific rhododendron. These differences in vegetation accounted for more of the variability found among these types than the environmental variables.

The Douglas-fir plant associations can be arrayed across the landscape based on distance from the coast, elevation, and topographic position (Figure 13). The Douglas-fir/Huckleberry Oak-Dwarf tanbark type and the Douglas-fir-Tanoak/Huckleberry Oak-Oceanspray type can be found within 20 miles of the coast. The highest cover of surface rock and moss were also found in these two vegetation types. A high percentage of moss covered rocks are apparently found in these associations as an indicator of higher moisture due to coastal fog or high relative humidity. Farther inland at greater than 20 miles from the coast the other five plant associations are found at different elevations and micropositions. The Douglas-fir-California Bay/Poison Oak type is found at low elevations and lower one-third slope positions where there are deeper soils and an increase in moisture. At upper slope positions, in or near draws the Douglas-fir/Huckleberry Oak-Pacific Rhododendron type is also responding to higher moisture and a colder microclimate. The Douglas-fir-Jeffrey Pine/California Fescue type, and the Douglas-fir-Incense Cedar/California Fescue type, are also found at upper slope positions and differ primarily in cover of California fescue and Jeffrey pine. The Douglas-fir/Huckleberry Oak type is found at all slope positions primarily inland at elevations above 2500 feet.

Some of these Douglas-fir plant associations can also be distinguished by differences in age class distribution. Age class distribution can be used as an indicator of the frequency of stand replacing fires. For example two plant associations with similar species composition have different age class distributions and therefore possibly a different return interval of stand replacing fires. The Douglas-fir-Jeffrey pine/California fescue type has a mean stand age of 174 years. The closely related Douglas-fir-Incense Cedar/California Fescue type has a mean

Table 6. Plant associations found in the Douglas-fir series.

EDP CODE	PLANT ASSOCIATION NAME
PSME-UMCA Subseries	Douglas-fir-California Bay Subseries
PSME-UMCA/RHDI	Douglas-fir-California Bay/Poison Oak
PSME-LIDE2 Subseries	Douglas-fir-Tanoak
PSME-LIDE2/QUVA-HODI	Douglas-fir-Tanoak/Huckleberry Oak-Ocean Spray
PSME-CADE3 Subseries	Douglas-fir-Incense Cedar
PSME-CADE3/FECA	Douglas-fir-Incense Cedar/California fescue
PSME-PIJE Subseries	
PSME-PIJE/FECA	Douglas-fir-Jeffrey Pine/California Fescue
PSME Subseries	
PSME/QUVA	Douglas-fir/Huckleberry Oak
PSME/QUVA-RHMA	Douglas-fir/Huckleberry Oak-Pacific Rhododendron
PSME/QUVA-LIDEE	Douglas-fir/Huckleberry Oak-Dwarf Tanbark

stand age of 269 years. This difference in age could indicate a higher incidence of stand replacing fires on the Jeffrey pine type compared to the Incense cedar dominated type. Most of the stands in this series had a mean age of 300 years with only two associations with a mean stand age less than 200 years.

Most of the plant associations in the Douglas-fir series had similar stand structure. Most stands had three layers of different height and diameter Douglas-firs. The Douglas-fir-Tanoak/Huckleberry oak-Ocean spray type had only two distinct structural layers of Douglas-firs. Mean stand dbh for each layer was similar for all plant associations. Average dbh ranged from 29 to 39 inches for the top tier. The Douglas-fir-Incense Cedar/California fescue type had the highest average dbh (39 in) for all associations in the Douglas-fir series. Mean stand height (135 ft.) for the top layer was the highest in the Douglas-fir/Huckleberry Oak-Pacific Rhododendron type and the lowest (105 ft) in the Douglas-fir/Huckleberry Oak-Dwarf tanbark type. Few of these stands had trees in the higher dbh classes (Figure 14). This may be an indication of the low productivity of these stands or the high disturbance intervals in several of these vegetation types.

Only one sensitive and three rare plants were found on serpentine sites dominated by Douglas-fir. The Sensitive plant, Oregon bleeding heart (*Dicentra formosa* var.*oregana*) and the rare species, Del Norte County iris (*Iris innominata*), Bolander's lily, and Siskiyou inside-out flower were found in Douglas-fir plant associations.

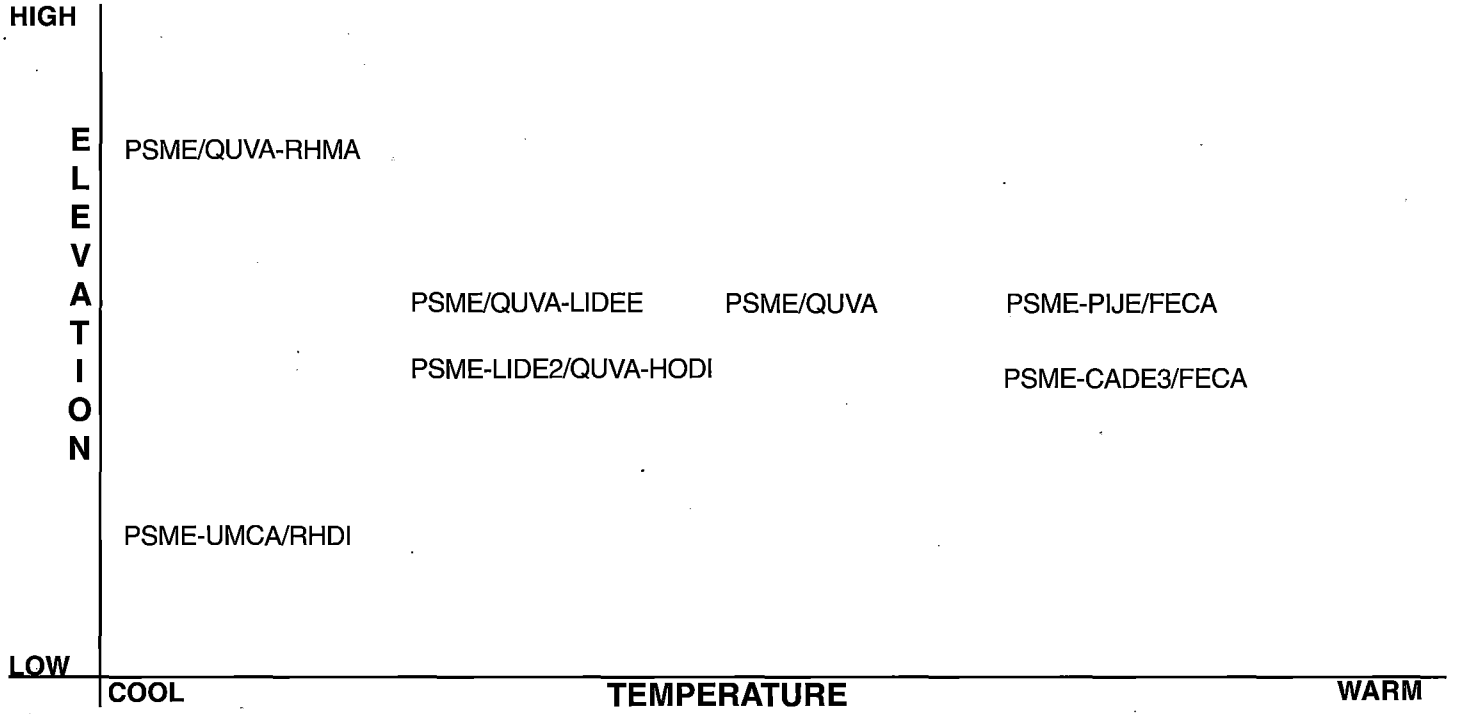


FIGURE 13 . Relative relationships of plant association in the Douglas-fir Series based on elevation and temperature.

Douglas-fir Series Key

1 a. California bay present in overstory and understory, cover ≥ 20% ..... PSME-UMCA/RHDI

1 b. California bay absent or not as above 2

2 a. Jeffrey pine cover ≥ 10%, California fescue present PSME-PIJE/FECA

2 b. Jeffrey pine or California fescue absent or not as above 3

3 a. Huckleberry oak cover ≥ 10% 4

4 a. Pacific rhododendron cover ≥ 10% ..... PSME/QUVA-RHMA

4 b. Pacific rhododendron absent or not as above . 5

5a. Tanoak and oceanspray present PSME-LIDE2/QUVA-HODI

5b. Tanoak or oceanspray absent 6

6 a. Dwarf tanbark cover ≥ 10% ..... PSME/QUVA-LIDEE

6 b. Dwarf tanbark absent or not as above .... PSME/QUVA

3 b. Huckleberry oak absent or not as above 7

7 a. California fescue cover ≥ 10% PSME-CADE3/FECA

7 b. California fescue absent or not as above . go back and try again

Douglas-fir-California Bay/ Poison Oak
PSME-UMCA/RHDI Association
EcoCode CD0HBC11

California bay
(Umbellularia californica)

Douglas-fir-California Bay/Poison Oak
PSME-UMCA/RHDI Association, EcoCode CD0HBC11

SUMMARY TABLE

(Sample Size:12)		COVER	CON
Tree Overstory Layer			
UMCA1	California Bay	36	100
PSME	Douglas-fir	50	91
ARME3	Pacific Madrone	11	66
Tree Understory Layer			
UMCA	California Bay	10	100
PSME	Douglas-fir	1	75
QUCH2	Canyon live Oak	1	50
CADE3	Incense Cedar	1	50
Shrubs			
RHDI	Poison Oak	5	83
LOHIV	Pink Honeysuckle	1	58
HEAR	Toyon	4	41
Herbs & Grasses			
POMU1	Swordfern	6	58
POCO4	Sierra Milkwort	1	41
TRLA3	Starflower	1	41
FECA	California Fescue	1	33

Environment

Elevation: 610-3580ft.

Aspect: S.W., W., N.E.

Slope: 10-65%

Slope Position: lower and middle 1/3

Surface Rock: 0-20%

Soils

Pit Depth: 28-41"+

Coarse Fragments: 7-80%

Textures: gl,vgl

Parent Material: serpentinite

Distribution/Environment

This type was found on the Gasquet, Orleans, Lower Trinity, and Ukonom ranger districts in middle and primarily lower one-third slope positions. The mean distance from the coast for this type was 27 miles. Elevation averaged 1400 ft and ranged from 610 to 3580 ft. This type had the lowest mean elevation for all serpentine vegetation types in the Douglas-fir series. Slopes were moderately steep (10%) to steep (65%) with an average of 39 percent. Slope aspects were southwest and northeast. The mean radiation index for this type was .494, the highest in the Douglas-fir series.

Soil Summary

The soils for this type were derived from serpentinite parent material. These soils were somewhat excessively well drained, moderately deep (75%) to deep (25%) with a slightly acid pH at the surface (6.5) and a neutral pH at the subsoil (6.6). These soils had a mean percent volume of coarse fragments in the A horizon of 33 percent with gravelly loam and very gravelly loam textures. The surface rock content of these soils was low with a mean of 7 percent. The available water holding capacity was high at 2.6 inches. This type had the highest A horizon thickness (12 in) for all serpentine vegetation types in this series. These soils were found in the mesic soil temperature regime and were classified in the Alfisol and Inceptisol soil orders. These soils were also classified into the subgroups, Ultic Haploxeralfs, Typic and Dystric Xerochrepts, and Lithic Xerorthents .

Vegetation

The total vegetation cover was moderate (45%) to high (98%) for this type with an average of 87 percent. Mean overstory cover was 77 percent one of the highest in the Douglas-fir series. The overstory was dominated by Douglas-fir (50%) with California bay (36%) and Pacific madrone (11%) dominating the mid-layer. The regeneration layer was dominated by California bay (10%) and Douglas-fir (1%) with canyon live oak (1%), and incense cedar (1%), occasionally present. The cover of shrub species was moderate with an average of 19 percent. The shrub layer was dominated by poison oak (6%), pink honeysuckle (2%) and toyon (*Heteromeles arbutifolia* var. *arbutifolia*) (4%). The forest floor was characterized by a 9% forb cover with only 3% grass cover. The forb layer consistently included swordfern (6%), a mesic site indicator. The grass layer was dominated by California fescue (1%).

Disturbance And Age Class Distribution

Stands found in this type ranged in age from 67 to 387 with an average age of 166 years. The highest frequency (40%) of stands was found in the less than 126 years age class. Seventy percent of all stands in this type were less than 200 years old. Only 10 percent of these stands were greater than 300 years old. The dominance of the younger age class may indicate that past disturbance included high frequency stand replacing fires. Many of these stands are adjacent to grasslands and oak woodlands as well as tanoak forests that are more susceptible to burning both from lightning strikes and man caused ignition. These fires may have carried over into these California Bay dominated stands as well.

Stand Structure Summary

These stands typically have two and sometimes three layers of both Douglas-fir and California bay. Douglas-fir dominates the top layer and is codominant with California bay in the lower two tiers. All heights and ages reported here are for Douglas-firs. The top tier is on average 169 years old with a height of 135 feet and a diameter of 33 inches. The second layer had an average age

of 94 years with a diameter of 22 inches and a height of 79 feet. The third layer was on average 116 years with a height of 43 feet and a diameter of 14 inches.

Softwood cubic volume was moderate with an average of 4700 ft^3. Hardwood cubic volume (1308 ft^3.) was the highest for all Douglas-fir vegetation types found on serpentine soil. Softwood basal area ranged from low (93 ft^2.) to high (360 ft^2) with an average of 213 ft^2. The Dunning site class mode was 2 and the site index was 150 ft at 300 years. The stand density index was 359.

Successional Trends

With fire suppression this type may become increasingly dominated by California bay. Without the openings created by fire, light availability for regenerating Douglas-fir will decrease and these trees may be out competed by California bay. Douglas-fir should ,however, remain a primary component of these stands as gaps are created by fallen dead and dying trees and other small scale disturbances.

Rare Plant Relationships

The rare species, Del Norte County iris and Yellow inside-out flower were found in the Douglas-fir-California Bay/Poison Oak type.

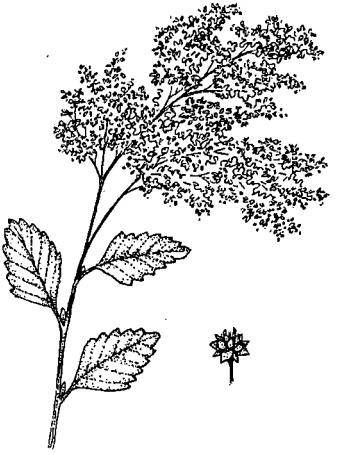
Management Implications

Harvesting for individual trees may be possible on these sites. Although there may be some difficulty with regeneration because of competition from hardwoods.

Closely Related Types

This type is found downslope from both serpentine and non-serpentine vegetation types. Serpentine vegetation types found upslope may include Jeffrey pine/Idaho fescue, Douglas-fir-Incense cedar/California fescue and some of the sugar pine and western white pine types. Non-serpentine types also found adjacent to this type, may include grasslands and black oak types. This type may also be replaced on non-serpentine soil by the Douglas-fir-Bigleaf Maple/swordfern type.

Douglas-fir-Tanoak/Huckleberry Oak-Ocean Spray
PSME-LIDE2/QUVA-HODI Association
EcoCode CD0HT012



ocean spray
(Holodiscus discolor)

huckleberry oak
(Quercus vaccinifolia)

Douglas-fir-Tanoak/Huckleberry Oak-Ocean Spray
PSME-LIDE2/QUVA-HODI Association, EcoCode CD0HT012

Summary Table

(Sample size: 4)

		COVER	CON
Tree Overstory Layer			
PSME	Douglas-fir	64	100
ARME3	Pacific Madrone	4	75
PILA	Sugar Pine	18	50
CADE3	Incense Cedar	15	50
LIDE2	Tanoak	20	25
Tree Understory Layer			
LIDE2	Tanoak	38	100
PSME	Douglas-fir	1	100
Shrubs			
QUVA	Huckleberry Oak	34	100
HODI	Ocean Spray	13	75
RHCA2	Coffeeberry	5	100
Herbs & Grasses			
VAHE	Western Vancouveria	3	100
XETE	Beargrass	2	100
CHUMO	Western prince's pine	2	100

Environment

Elevation: 2430-3600 ft.

Aspect: N., S.W., NW.

Slope: 20-60%

Slope Position: upper and middle 1/3

Surface Rock: 5-80%

Soils

Pit Depth: 27-40"+

Coarse Fragments: 35-75%

Textures: gl,vgl

Parent Material: serpentine

Distribution/Environment

This type was found on the Orleans ranger district in upper and middle one-third slope positions. Elevation averaged 3112 feet and ranged from 2430 to 3600 feet. Slopes were steep (40%), southwest and west facing. The mean radiation index for this type was .428 which is slightly higher than the other plant associations found in the Douglas-fir series.

Soil Summary

The soils for this type were derived from serpentinite parent material. These soils were somewhat excessively drained, moderately deep (75%) to deep (25%) with slightly acid pH at both at the surface (6.3) and the subsoil (6.5). These soils had the highest mean percent volume of coarse fragments in the A horizon (53%) of all serpentine plant associations in the Douglas-fir series. The high rock fragment content of these soils is reflected in the low AWC of 1.2 inches. These soils were found in the mesic soil temperature regime and had moderately low productivity for conifer growth. The dominant soil family was loamy skeletal, serpentinitic, mesic, Typic Xerochrept.

Vegetation

The mean total vegetation cover for this type was 95%. The overstory cover was the highest in the Douglas-fir series at 90%. The dominant overstory species was Douglas-fir (64%) and with sugar pine (18%) and incense cedar (15%) as occasional codominants. Pacific madrone (2%) was consistently included in the mid-layer. Tanoak was found in the mid-layer of one plot in this type and had a cover of 20%. The regeneration layer was consistently dominated by tanoak with a mean percent cover of 38 percent. Douglas-fir (1%) and Incense cedar (1%) were also included in the regeneration layer. This type has a dense shrub layer with a mean of 76 percent. The structure of this layer also includes the tanoak regeneration. Shrubs that dominate this type include huckleberry oak (34%) and ocean spray (13%) with coffeeberry (5%). Wood rose (3%), red huckleberry (4%), and dwarf Oregon-grape (2%) were also present in the shrub layer. The forb layer had an average cover of 7 percent. It often included western vancouveria (*Vancouveria hexandra*) (2%), beargrass (2%) and western prince's pine (1%). The grass layer was almost nonexistent in this type with a mean cover of .5 percent.

Disturbance And Age Class Distribution

This type had stand ages that ranged from 123 to 550 years old with an average age of 321 years. Fifty percent of these stands were dominated be age classes that were less than 200 years old. Twenty-five percent of these stands were greater than 300 years old. The position of these stands at upper and mid-slopes would increase the probability of disturbance by fire. However, considering the age distributions, fire intervals and intensity may be variable. The younger stands (<200 years) may be the result of the last stand replacing fire.

Stand Structure Summary

Many of the stands in this type were dominated by two layers of Douglas-firs. The age of the top layer was on average 265 years old with a height of 125 ft. and a diameter of 33 inches. The second layer was 158 years old with a height of 95 ft. and a diameter of 19 inches.

Softwood cubic volumes were moderate with an average of 5325 ft^3. Softwood basal area was also moderate with an average of 210 $ft.^2$. Hardwood cubic volume was low at 157 ft^3. The Dunning site class mode was 3 with a site index of 125 at 300 years. Stand density index was moderate with an average of 331.

Successional Trends

Without high intensity fires, Douglas-fir will continue to dominate these sites. A high severity burn could eliminate Douglas-fir from the overstory. After a high severity burn, tanoak may show increased growth and regeneration, but may still be limited to the shrub layer due to other environmental factors. The low soil fertility and temperature on these sites may limit the growth potential of tanoak and keep it in the understory.

Rare Plant Relationships

No sensitive or rare plants have been identified in this type to date.

Management Implications

Silvicultural treatments on stands of this vegetation type should be limited to individual tree selection. The low productivity and rocky soils of this type limit its regeneration potential. This type may be best managed for wildlife and rare plant species.

Closely Related Types

This type is closely related to the Douglas-fir/Huckleberry Oak type. The difference between these two types is the absence of tanoak in the Douglas-fir/Huckleberry Oak type. The Douglas-fir-Tanoak/Huckleberry Oak-Ocean spray type has a higher amount of surface rock than the Douglas-fir/Huckleberry Oak type. On adjacent non-serpentine sites this type is replaced by plant associations in the tanoak series.

Douglas-fir-Incense Cedar/ California Fescue PSME-CADE3/FECA Association EcoCode CD0CCI11

California fescue
(Festuca californica)

Douglas-fir-Incense Cedar/California Fescue
PSME-CADE3/FECA Association, EcoCode CD0CCI11

SUMMARY TABLE

(Sample Size:10)		COVER	CON
Tree Overstory Layer			
PSME	Douglas-fir	42	100
CADE3	Incense Cedar	18	91
ARME3	Pacific Madrone	10	66
Tree Understory Layer			
PSME	Douglas-fir	4	100
CADE3	Incense Cedar	2	91
QUCH2	Canyon live Oak	1	66
LIDE2	Tanoak	2	58
UMCA1	California Bay	2	50
Shrubs			
RHDI	Poison Oak	1	58
QUVA	Huckleberry Oak	2	25
Herbs & Grasses			
FECA	California Fescue	67	100
HIAL	White Hawkweed	1	91
IRI	Iris sp.	1	66
POMU1	Swordfern	1	50
WHMO	Western modesty	5	41

Environment

Elevation: 1360-2750 ft.

Aspect: S.W., N.E.

Slope: 10-65%

Slope Position: upper and middle 1/3

Surface Rock: 1-9%

Soils

Pit Depth: 14-40"+

Coarse Fragments: 20-45%

Textures: vgl,gl,gsil

Parent Material: serpentine

Distribution/Environment

This type was found on the Gasquet, Orleans, Happy Camp, and Ukonom ranger districts in upper and middle one-third slope positions. This type was typically found 24 miles from the Pacific Ocean. Elevation averaged 2348 feet and ranged from 1360 to 4170 feet. Slopes were gently sloping (10%) to very steep (65%) with an average of 39 percent. Slope aspects were west and south. The mean radiation index for this type was .471, one of the highest in the Douglas-fir series.

Soil Summary

The soils for this type were derived from serpentinite parent rocks. These soils were somewhat excessively well drained, shallow (30%), moderately deep (30%) and deep (40%) with a neutral pH both at the surface (6.7) and the subsoil (7.0). These soils had a mean percent volume of coarse fragments in the A horizon of 29 percent with gravelly loam, very gravelly loam and gravelly silty loam textures. The surface rock of the soils was low, ranging from 0% to 5% with a mean of 2 percent. The available water holding capacity was high at 2.5 inches and A horizon thickness was 5 inches. These soils were found in the mesic soil temperature regime and were classified in the Alfisol, Mollisol, Inceptisol, and Entisol soil orders. These soils were typically classified into the subgroups Ultic Haploxeralfs, Typic Xerumbrepts, Typic Xerochrepts, and Typic Xerorthents.

Vegetation

The mean total vegetation cover for this type was high with an average of 91 percent. Mean overstory cover was 68 percent. The overstory was dominated by Douglas-fir (42%) and incense cedar (18%). Pacific madrone also contributed to the overstory with an average cover of (10%). The regeneration layer was dominated by Douglas-fir (4%) and incense cedar (2%). Total shrub cover was low, and ranged from 0% to 10% with an average of 4%. This type is not dominated by a single shrub species but shrubs such as wood rose (1%), poison oak (1%), and huckleberry oak (2%) were occasionally present. Mean forb cover was low (8%) and was dominated by swordfern (1%), white hawkweed (1%) and western modesty (5%). The mean cover of grass was high (66%) and was dominated by California fescue (57%).

Disturbance And Age Class Distribution

Stands found in this type ranged in age from 126 to 429 years with an average age of 243 years. Stand ages in this type were equally distributed across all age classes. The frequency of stands above 300 years was 40% and the frequency of stands below 200 years was 30%. Variable fire frequency and intensity may be contributing to the different aged stands found in this type. Fire is probably an influence on many of these stands considering their topographic position in upper and middle one-third slopes, where the probability of lightning strikes is high.

Stand Structure Summary

This plant association typically has three layers of trees in the overstory. All of these layers are dominated by Douglas-fir. The top tier is on average 223 years old with a height of 132 feet and a diameter of 39 inches. The second layer had an average age of 214 years with a diameter of 30 inches and a height of 100 feet. The third layer was on average 100 years with a height of 91 feet and a diameter of 18 inches.

Softwood cubic volume was moderate with an average of 6748 $ft.^3$ and ranged from 4300 $ft.^3$ to 11,400 $ft.^3$. Softwood basal area ranged from moderately low (160 ft^2) to high (467 ft^2) with an average of 243 ft^2. Dunning site class had a

mode of 4 and a site index of 100 ft at 300 years old. The stand density index was 400, the highest for all serpentine vegetation types within the Douglas-fir series.

Successional Trends

The Douglas-fir-Incense Cedar/California Fescue plant association has low potential for change in species composition and structure with continued fire suppression. No other species is present in the overstory and understory that could compete with Douglas-fir and incense cedar for dominance. A stand replacing fire may result in a more open stand with Douglas-fir and Incense cedar regenerating.

Rare Plant Relationships

The rare plant, Del Norte County iris was found in this type.

Management Implications

The productivity of these soils appears to be variable as indicated by the site class index. Sites with higher productivity could be selectively cut but consideration should be given to the regeneration potential after the soil is disturbed. Competition from grasses may also limit the regeneration potential of this type.

Closely Related Types

The species composition of this type is similar to the Douglas-fir-Jeffrey Pine/California fescue type. These types differ in amount of grass cover. The Douglas-fir-Incense cedar type has an average grass cover of 66% whereas the Douglas-fir-Jeffrey pine type has a grass cover of 38%. Also Jeffrey pine are nonexistent or rare in the incense cedar dominated stands. Higher hardwood volume in the Douglas-fir-Incense Cedar/California Fescue type may also be an indication of environmental differences between these types.

Douglas-fir-Jeffrey Pine/California Fescue
PSME-PIJE/FECA Association
EcoCode CDOCPJ11

California fescue
(Festuca californica)

Douglas-fir-Jeffrey Pine/California fescue
PSME-PIJE/FECA Association, EcoCode CDOCPJ11

SUMMARY TABLE

(Sample Size:14)		COVER	CON
Tree Overstory Layer			
PSME	Douglas-fir	43	100
PIJE	Jeffrey Pine	15	92
CADE3	Incense Cedar	13	71
ARME3	Pacific Madrone	9	71
Tree Understory Layer			
PSME	Douglas-fir	2	92
PIJE	Jeffrey Pine	1	42
CADE3	Incense Cedar	2	78
Shrubs			
RHDI	Poison Oak	2	50
ROGY	Wood Rose	1	42
SYMO	Creeping Snowberry	1	35
Herbs & Grasses			
FECA	California Fescue	42	85
IRI	Iris sp.	1	71
HIAL	White Hawkweed	1	64
POMU1	Swordfern	2	42

Environment

Elevation: 1740-4700 ft.

Aspect: N.W., S.E., W.

Slope: 13-58%

Slope Position: upper and middle 1/3

Surface Rock: 0-25%

Soils

Pit Depth: 11-40"+

Coarse Fragments: 15-44%

Textures: l,gl,gsil

Parent Material: serpentinite, greenstone

Distribution/Environment

This type was found on the Gasquet, Orleans, Lower Trinity, Happy Camp, and Ukonom ranger districts. The mean distance from the coast was 34 miles. This type is typically found in upper and middle one-third slope positions. Elevation averaged 2979 feet and ranged from 1740 to 4700 feet. Slopes were gently sloping (13%) to steep (58%) with an average of 37 percent. Slope aspects were northwest, east, and southwest. The mean radiation index was relatively high at .444 which is reflective of the southwest facing slopes.

Soil Summary

The soils for this type were derived from serpentinite and greenstone parent rock. These soils were well drained, shallow (15%) to deep (46%) with slightly acid pH at both at the surface (6.3) and the subsoil (6.6). These soils had a mean percent volume of coarse fragments in the A horizon of 28 percent with loam, gravelly loam and gravelly silty loam textures. The surface rock of these soils was moderately low with a mean of 3 percent. The available water holding capacity (2.6 in.) was the highest of the Douglas-fir plant associations. A horizon thickness was 6 inches. These soils were found in the mesic and frigid soil temperature regimes and were identified as both the Alfisols and Inceptisols. For the Alfisols the dominant family was the Loamy skeletal, mixed, mesic, ultic Haploxeralf. Those soils in the inceptisol order were in the subgroups, Typic Xerochrept and Typic Xerumbrept.

Vegetation

The mean total vegetation cover for this type was high (93%) and was characterized by a moderately dense tree layer (77%). The tree layer was dominated by Douglas-fir (43%), Jeffrey pine (15%), Incense cedar (13%), and Pacific madrone (9%). The tree understory or regeneration layer was dominated by Douglas-fir (2%), Incense cedar (2%), and Jeffrey pine (1%). The shrub and herb layers were sparse with 8% and 6% mean cover respectively. Poison oak (3%) dominated the shrub layer and iris (1%), white hawkweed (1%), and swordfern (2%) dominated the herb layer. This type has a high cover of grass (38%) dominated by California fescue (42%).

Disturbance And Age Class Distribution

Stands found in this type ranged in age from 66 to 410 years with an average of 175 years. The highest frequency of stands were in the less than 126 year age class. The frequency of stands below 200 years old was 54 percent and the frequency of stands above 300 years was 15 percent. The dominance of younger age classes appear to be the result of high frequency of stand replacing fires in this type.

Stand Structure Summary

This type has stands the are relatively uneven aged with intolerant and moderately tolerant species. Douglas-fir seedlings grow moderately well in shade and Jeffrey pines need sunlight throughout all stages of growth. Three layers of trees are typically found in these stands. Both Douglas-fir and Jeffrey pine dominate the top layer which is on average 174 years old with a height of 118 feet and a diameter of 29 inches. In the lower layers Jeffrey pine is often out competed by Douglas-fir and sometimes Incense cedar. The second layer had an average age of 134 years old with a height of 107 feet and a diameter of 27 inches. The third layer was dominated by Douglas-fir and was 136 years old with a height of 60 feet and a diameter of 15 inches.

The softwood basal area of these stands was moderate with an average of 203 ft^2. Softwood cubic volume was also moderate at 6260 ft^3. The mean hard-

wood cubic volume in this type was 207 ft^3, which was typical of most associations in the Douglas-fir series (in this guide). The median Dunning site class was 2 with site index of 150 at 300 years. Stand density index was moderate with an average of 350.

Successional Trends

Jeffrey pine may not maintain itself in these stands with fire suppression. The continued regeneration of Douglas-fir may limit the Jeffrey pine in the understory due to competition for light. Because Jeffrey pine is relatively intolerant these stands may eventually be completely dominated by Douglas-fir.

Rare Plant Relationships

No sensitive or rare plants have been found in this type to date.

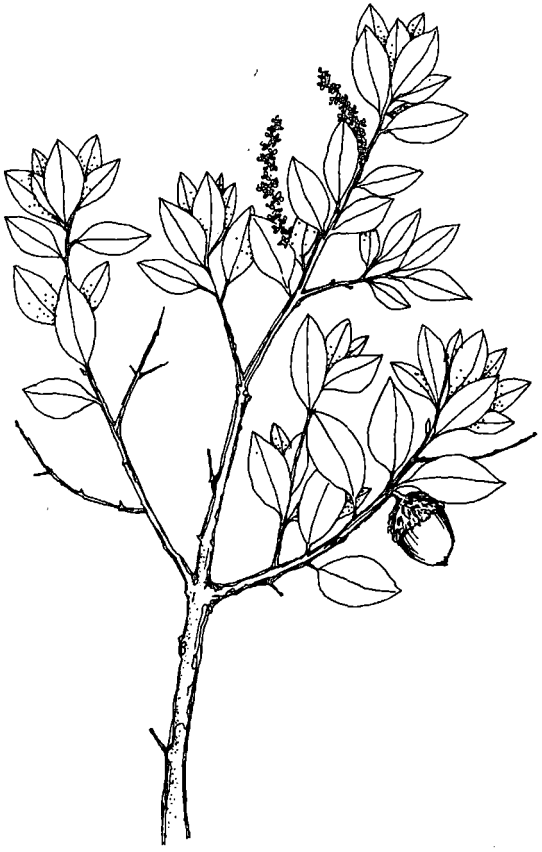
Management Implications

Management of these stands may be limited to select cuts with long rotations. The low productivity of the serpentine soils may dictate the amount of regeneration and recovery of the stand from harvest. Regeneration success may also be limited by competition from the dense grass layer. A selective harvest could also be used to maintain Jeffrey pine in this type.

Closely Related Types

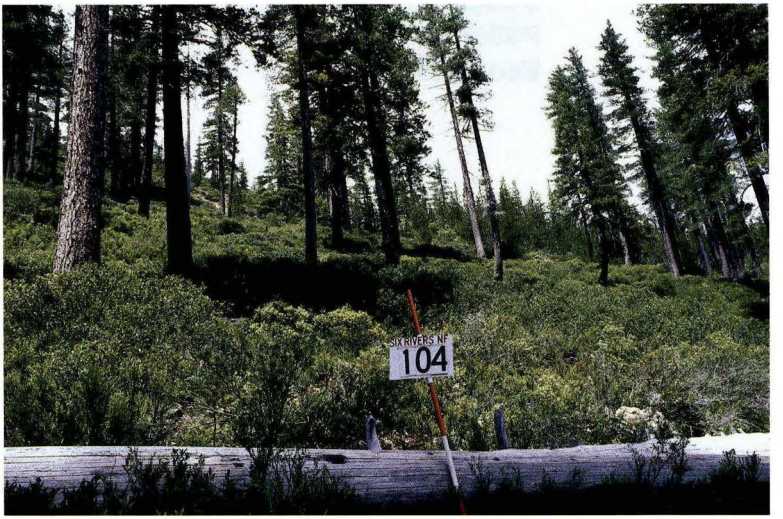
The species composition of this type is similar to the Douglas-fir-Incense cedar/California fescue type. The Douglas-fir-incense cedar/California fescue type has a greater mean grass cover and has very little Jeffrey pine compared to the Douglas-fir-Jeffrey pine/California fescue type. The Douglas-fir-Incense cedar/California Fescue type also has a much higher mean hardwood volume than the Douglas-fir-Jeffrey Pine/California Fescue type. The higher grass cover and higher volume of hardwoods in the Douglas-fir-Incense Cedar/ California Fescue type could indicate an environmental difference between these types that has not yet been measured.

Douglas-fir/Huckleberry Oak
PSME/QUVA Association
EcoCode CD0HO11



huckleberry oak
(Quercus vaccinifolia)

Douglas-fir/Huckleberry Oak
PSME/QUVA Association, EcoCode CD0HO11



SUMMARY TABLE

(Sample Size:26)		COVER	CON
Tree Overstory Layer			
PSME	Douglas-fir	37	100
PILA	Sugar Pine	12	88
CADE3	Incense Cedar	5	69
Tree Understory Layer			
PSME	Douglas-fir	2	80
CADE3	Incense Cedar	1	73
LIDE2	Tan Oak	8	57
Shrubs			
QUVA	Huckleberry Oak	39	100
VAPA	Red Huckleberry	11	61
BENE1	Dwarf Oregon-grape	3	57
Herbs & Grasses			
CHUMO	Western prince's pine	2	80
WHMO	Western modesty	6	73
XETE	Beargrass	6	57
TRLA3	Starflower	2	57
IRI	Iris sp.	1	57

Environment

Elevation: 2500-4440 ft.

Aspect: N.W., E., S.W.

Slope: 10-70%

Slope Position: upper, middle, and lower 1/3

Surface Rock: 1-35%

Soils

Pit Depth: 13-40"+

Coarse Fragments: 20-45%

Textures: vggl,vgl,gl,gsil

Parent Material: serpentinite, mafic,ultramafic,granite

Distribution/Environment

This type was found on the Gasquet, Orleans, Happy Camp, and Ukonom ranger districts in upper, middle, and lower one-third slope positions. This type was typically found inland at approximately 30 miles from the coast. Elevation averaged 3393 feet and ranged from 2500 to 4440 feet. Slopes were strongly sloping (10%) to very steep (70%) with an average of 50 percent. Slope aspects were northwest, east, and southwest. The mean radiation index (.377) was one of the lowest in the Douglas-fir series. This index may be an indicator of cooler northwest facing slopes.

Soil Summary

The soils for this type were derived from serpentinite, peridotite and granitic parent material. These soils were well drained, shallow (24%) moderately deep (52%) and deep (24%) with a slightly acid pH at the surface (6.4) and a neutral pH at the subsoil (6.6). These soils had a mean percent volume of coarse fragments in the A horizon of 36 percent with gravelly loam, very gravelly loam and gravelly silt loam textures. The surface rock of the soils was low (1%) to moderate (35%) with a mean of 10 percent. The available water holding capacity was relatively low at 1.6 inches and A horizon thickness was 5 inches. These soils were found in the mesic soil temperature regime and were classified in the Alfisol, Inceptisol, and Entisol soil orders. These soils were also classified into the subgroups Ultic Haploxeralfs, Typic and Dystric Xerochrepts, and Lithic Xerorthents.

Vegetation

The mean total vegetation cover for this type was high with an average of 91 percent. Mean tree cover was 60 percent. The overstory was dominated by Douglas-fir (37%) with sugar pine (12%) and Incense cedar (5%) as codominants. Hardwoods such as Pacific madrone (6%) and tanoak (6%) also contributed to the tree layer. The regeneration layer was dominated by Douglas-fir (2%) and Incense cedar (1%). The cover of shrub species was high with an average of 53 percent. This layer was dominated by huckleberry oak (39%) with red Huckleberry (11%) and occassionally dwarf Oregon-grape (3%). Mean forb cover was moderate (14%) and dominated by western prince's pine (2%), beargrass (5%) and western modesty (6%). The grass cover was also low (3%) with western fescue (1%) dominating.

Disturbance And Age Class Distribution

Stands found in this type ranged in age from 111 to 557 years with an average age of 317 years old. The highest frequency (34%) of stands was found in the 276 to 325 year age class. The frequency of stands above 300 years was 54% and the frequency of stands below 200 years was 12%. The dominance of older age classes may indicate low frequency of disturbance by fire on some of these sites. Since this type covers all slope positions, it is possible that younger stands may be at the upper slope positions where the probability of lightning strikes is greater. Conversely, stands at lower slope positions may have lower fire return intervals and therefore are older.

Stand Structure Summary Stands

In this type are moderately dense with two and sometimes three layers of different age and size class Douglas-fir. The top tier is on average 297 years old with a height of 127 feet and a diameter of 34 inches. The second layer had an average age of 234 years with a diameter of 26 inches and a height of 94 feet. The third layer was on average 212 years with a height of 61 feet and a diameter of 17 inches.

Softwood cubic volume was moderate with an average of 6259 ft^3. Softwood basal area ranged from low (93 ft^2) to high (360 ft^2) with an average of 213 ft^2. The Dunning site class mode was 3 with a site index of 125 at 300 years. Stand density index was moderate with an average of 316.

Successional Trends

With continued fire suppression Douglas-fir should continue to dominate these sites. A high intensity fire may increase the sprouting of tanoak but due to the low nutrient content of the soil it is unlikely that tanoak will dominate these sites.

Rare Plant Relationships

The sensitive species, Oregon bleeding heart and the rare species Bolander's lily were found in this type.

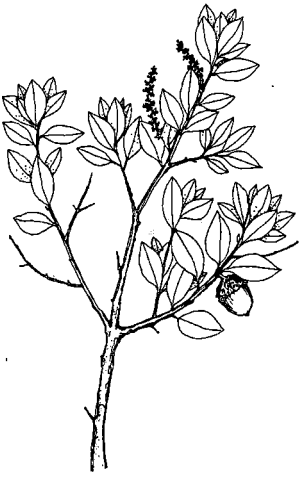
Management Implications

Management of these stands may be limited to select cuts with long rotations. The productivity of the soils, make these stands less desirable for intensive timber harvest. Regeneration may also be difficult due to the competition from shrubs and the rocky soils.

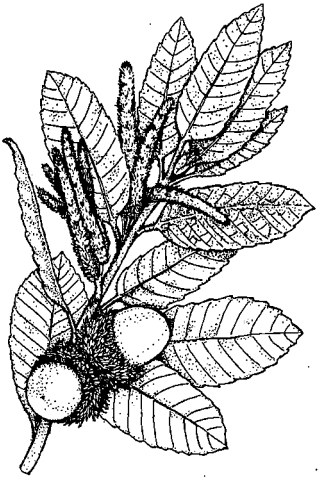
Closely Related Types

This type is replaced on coastal sites by the Douglas-fir/Huckleberry oak-Dwarf tanbark type. The main difference between these types is the presence and dominance of dwarf tanbark along the coast. The Douglas-fir/Huckleberry Oak type also grades into the Port Orford Cedar-Douglas-fir/Huckleberry Oak types in lower one-third slopes. This type is also replaced by Port Orford Cedar/ Western Azalea in riparian areas.

Douglas-fir/Huckleberry Oak-Dwarf tanbark
PSME/QUVA-LIDEE Association
EcoCode CD0SOH12

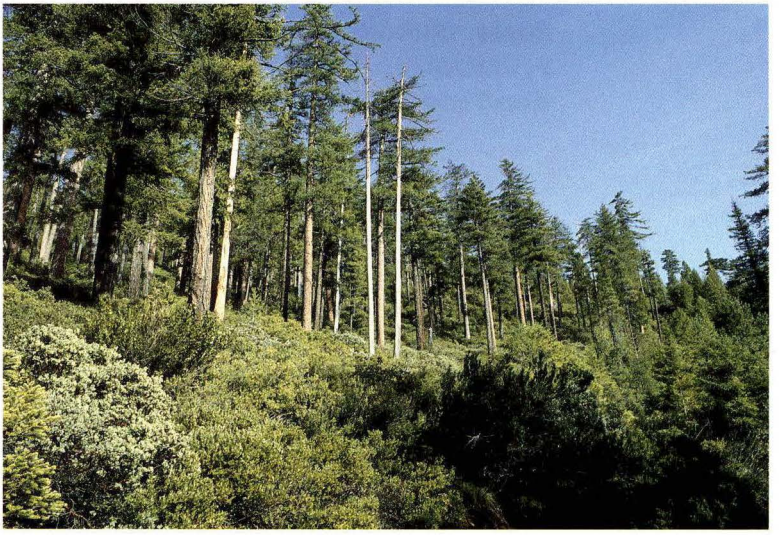


huckleberry oak
(Quercus vaccinifolia)



dwarf tanbark
(Lithocarpus densiflorus var. *echinoides)*

Douglas-fir/Huckleberry Oak-Dwarf tanbark PSME/QUVA-LIDEE Association, EcoCode CD0SOH12



SUMMARY TABLE

(Sample Size:11)		COVER	CON
Tree Overstory Layer			
PSME	Douglas-fir	28	100
PILA	Sugar Pine	16	81
CADE3	Incense Cedar	3	36
Tree Understory Layer			
PSME	Douglas-fir	2	90
PILA	Sugar Pine	1	81
UMCA	California Bay	6	63
Shrubs			
QUVA	Huckleberry Oak	52	100
VAPA	Red Huckleberry	13	100
LIDEE	Dwarf tanbark	15	81
Herbs & Grasses			
WHMO	Western modesty	6	81
CHUMO	Western prince's pine	2	81
XETE	Beargrass	2	81
PYPID	Nootka Wintergreen	1	63

Environment

Elevation: 3220-4040 ft.

Aspect: S.W.,N.W.

Slope: 30-65%

Slope Position: upper and middle 1/3

Surface Rock: 2-26%

Soils

Pit Depth: 12-35"

Coarse Fragments: 20-72%

Textures: vgl,gl

Parent Material: serpentine, ultramafic

Distribution/Environment

This type was found on the Gasquet and Orleans ranger districts in middle and upper one-third slope positions. This type was influenced by a maritime climatic regime with a mean distance from the Pacific Ocean of 19 miles. Elevation averaged 3521 feet and ranged from 3220 to 4040 feet. Slopes were steep (30%) to very steep (65%) with an average of 47 percent. Slope aspects were southwest and northwest. The mean radiation index for this type was .444.

Soil Summary

The soils for this type were derived from serpentinite and peridotite parent material. These soils were somewhat excessively well drained, shallow (18%) to moderately deep (82%) with a moderately acid pH at the surface (6.0) and a slightly acid pH at the subsoil (6.5). These soils had one of the highest mean percent volume of coarse fragments in the A horizon (45%). The surface rock content of these soils was low (2%) to moderate (26%) with a mean of 17 percent. The available water holding capacity was relatively low at 1.6 inches and A horizon thickness was 6 inches. These soils were found in the mesic soil temperature regime and were classified in the Alfisol and Inceptisol soil orders. The dominant soil family was loamy skeletal, serpentinitic, Typic Xerochrept.

Vegetation

The total vegetation cover for this type was high and ranged from 95 to 99 with an average of 97 percent. Mean tree cover was 49 percent, the lowest of all the serpentine plant associations in the Douglas-fir series. The tree layer was dominated by Douglas-fir (28%) with Sugar pine (16%) as a codominant and Incense cedar (3%) occasionally present. The regeneration layer was dominated by Douglas-fir (2%) and sugar pine (1%). This type had a dense cover of shrub species with a mean of 84 percent. The shrub layer was dominated by huckleberry oak (52%) with dwarf tanbark (15%) and red huckleberry (13%) as associates. Mean forb cover was moderate (12%) for this type. The forb layer was dominated by western prince's pine (2%) and western modesty (6%). The mean grass cover was very low (2%) and was occasionally dominated by western fescue (1%).

Disturbance And Age Class Distribution

Stands found in this type ranged in age from 87 to 465 years with an average age of 304 years. These stands were found in all age classes with the highest frequency (27%) in the 176 year to 225 year class and the 326 year to 375 year age class. The frequency of stands above 300 years was 46% and the frequency of stands below 200 years was 9%. The dominance of older age classes indicates that the moist condition of these stands may not be conducive to high intensity stand replacing fires.

Stand Structure Summary

Stands in this type have a low to moderate tree cover with three layers of different age, height and size class Douglas-firs. The top tier was on average 269 years old with a height of 105 feet and a diameter of 33 inches. The second layer had an average age of 250 years with a diameter of 25 inches and a height of 83 feet. The third layer was on average 175 years old with a height of 53 feet and a diameter of 16 inches.

Softwood cubic volume was moderate with averages of 5263 ft^3. Softwood basal area ranged from very low (67 ft^2) to high (333 ft^2) with an average of 189 ft^2. Dunning site class mode was 4 and the mean site index was 100 ft at 300 years. The stand density index was 272, the lowest of the serpentine types found in the Douglas-fir series.

Successional Trends

The tree overstory and regeneration layer do not indicate that Douglas-fir will forfeit dominance in this type. A high severity burn may eliminate Douglas-fir in some stands where it may initially be replaced by knobcone or lodgepole pine during early seral development.

Rare Plant Relationships

The rare plant, Bolander's lily was found in this type.

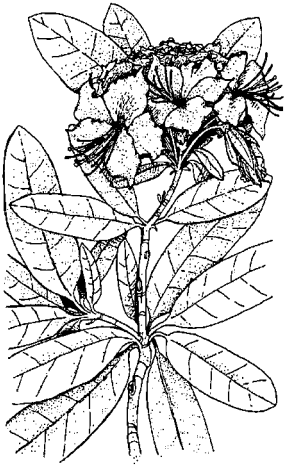
Management Implications

The site quality of this type does not make it conducive to intensive timber management. This type is best managed as habitat for small mammals, birds and rare plant species.

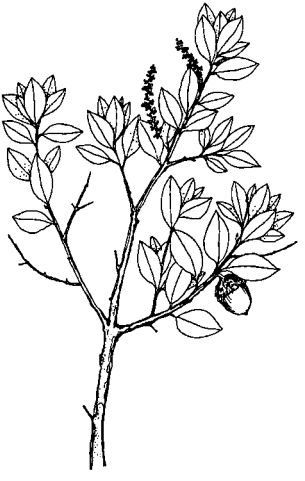
Closely Related Types

This type is replaced on inland sites by the Douglas-fir/Huckleberry Oak type The Douglas-fir/Huckleberry Oak type has a slightly lower mean volume of coarse fragments in the A horizon and overall higher productivity than the Douglas-fir/ Huckleberry Oak-Dwarf tanbark type. The Douglas-fir/Huckleberry Oak-Dwarf tanbark type is also found along the same slopes as the Jeffrey pine/Idaho fescue type.

Douglas-fir/Huckleberry Oak-Pacific Rhododendron
PSME/QUVA-RHMA
EcoCode CD0SOH13



Pacific rhododendron
(Rhododendron macrophyllum)



huckleberry oak
(Quercus vaccinifolia)

Douglas-fir/Huckleberry Oak-Pacific Rhododendron PSME/QUVA-RHMA Association, EcoCode CD0SOH13

SUMMARY TABLE

(Sample size: 4)		COVER	CON
Tree Overstory Layer			
PSME	Douglas-fir	54	100
PILA	Sugar pine	7	75
CADE3	Incense Cedar	5	50
Tree Understory Layer			
PSME	Douglas-fir	1	75
ABCO	White fir	1	50
CADE3	Incense Cedar	1	50
Shrubs			
QUVA	Huckleberry Oak	19	100
RHMA	Pacific Rhododendron	13	100
VAPA	Red Huckleberry	15	100
LIDEE	Dwarf tanbark	10	100
Herbs & Grasses			
POMU1	Swordfern	2	75
XETE	Beargrass	5	75
IRI	Iris	1	50

Environment

Elevation: 2490-4240 ft.

Aspect: N, N.E.

Slope: 15-65%

Slope Position: upper and lower 1/3

Surface Rock: 7-11%

Soils

Pit Depth: 15-40"+

Coarse Fragments: 10-55%

Textures: vgl, l, vksl

Parent Material: serpentine

Distribution/Environment

This type was found on the Gasquet, and Orleans ranger districts in upper and lower one-third slope positions. This type is often limited to moist areas such as draws or the headwaters to small creeks. The mean distance from the Pacific Ocean for this type is 21 miles. Elevation averaged 3245 feet and ranged from 2490 to 4240 feet. Slopes were typically steep (46%) ranging from strongly sloping (15%) to very steep (65%). Slope aspect was north and northeast. The mean radiation index for this type was .351. This low index reflects the cooler northeast slopes.

Soil Summary

The soils for this type were derived from serpentinite parent material. These soils were somewhat excessively well drained and either shallow (50%) or deep (50%) with a slightly acid pH at the surface (6.2) and a neutral pH at the subsoil (6.7). These soils had a mean percent volume of coarse fragments in the A horizon of 29 percent with loam and very gravelly loam textures. The surface rock of the soils was low with a mean of 8 percent. The available water holding capacity was moderately low at 1.8 inches and A horizon thickness was 5 inches. These soils were found in the mesic and frigid soil temperature regimes. All of these soils were inceptisols with the coarse loamy, mixed, mesic, Typic Xerochrept family dominating.

Vegetation

The total vegetation cover for this type was high ranging from 95% to 99% with an average of 96 percent. Mean overstory tree cover was 66 percent. Douglas-fir dominated the overstory with 54% characteristic cover. Sugar pine (7%), incense cedar (5%), and western white pine (3%) were also often found in the overstory. The regeneration layer included Douglas-fir (1%) and occasionally white fir (1%) and incense cedar (1%). The shrub layer was high with an average cover of 77 percent. A variety of shrubs were found in this type including, huckleberry oak (19%), pacific rhododendron (13%), dwarf tanbark (10%) and red huckleberry (15%). The forb cover on this site was low at 10 percent. Forbs found in this type include swordfern (2%) and beargrass (5%). The grass cover was very low (1%) and was dominated by western fescue (1%).

Disturbance And Age Class Distribution

Stands in this type ranged in age from 142 to 400 years old with an average of 286 years. Disturbance of these stands is highly variable considering their microposition in depressions and draws. This disturbance frequency is reflected in the disjointed age class distribution. These stands were either relatively young or very old. Fifty percent of these stands were below 200 years old and 50% were greater than 300 years old. Stand age in this case is most likely related to slope position. Sites that are found at upper slope positions would be more susceptible to lightning strikes. Stands on the upper slopes would have a higher occurrence of stand replacing fires resulting in younger trees over time. Those stands at lower slope positions will be older due to the lower frequency of fire.

Stand Structure Summary

Depending upon the seral stage of these stands they either had two or three layers of trees. Mature or early mature stands usually have two layers and old growth stands have three or more layers. All of the layers were dominated by Douglas-fir. The top layer of these stands was 286 years old with an average diameter of 34 inches and a height of 121 ft. The second layer was typically younger with an average age of 186 years with a height of 84 feet and a diameter of 22 inches. The third layer was 95 years with a height of 36 ft and a

diameter of 8 inches.

The stands in this type had from low (1600 cu.ft.) to high (11,300 cu.ft.) softwood cubic volume with an average of 5700 cu.ft. The softwood basal area for this type was 235 and ranged from 67 to 360. Hardwood cubic volume was low at 150 ft^3. The mode of the Dunning site class index was 3 with a stand index of 125 at 300 years. The stand density index was 295 one of the lowest in the Douglas-fir series.

Successional Trends

This type will most likely remain dominated by Douglas-fir in the long term as this is the primary regenerating and overstory species.

Rare Plant Relationships

The rare plant, Bolander's lily was found in the Douglas-fir/Huckleberry Oak-Pacific Rhododendron type.

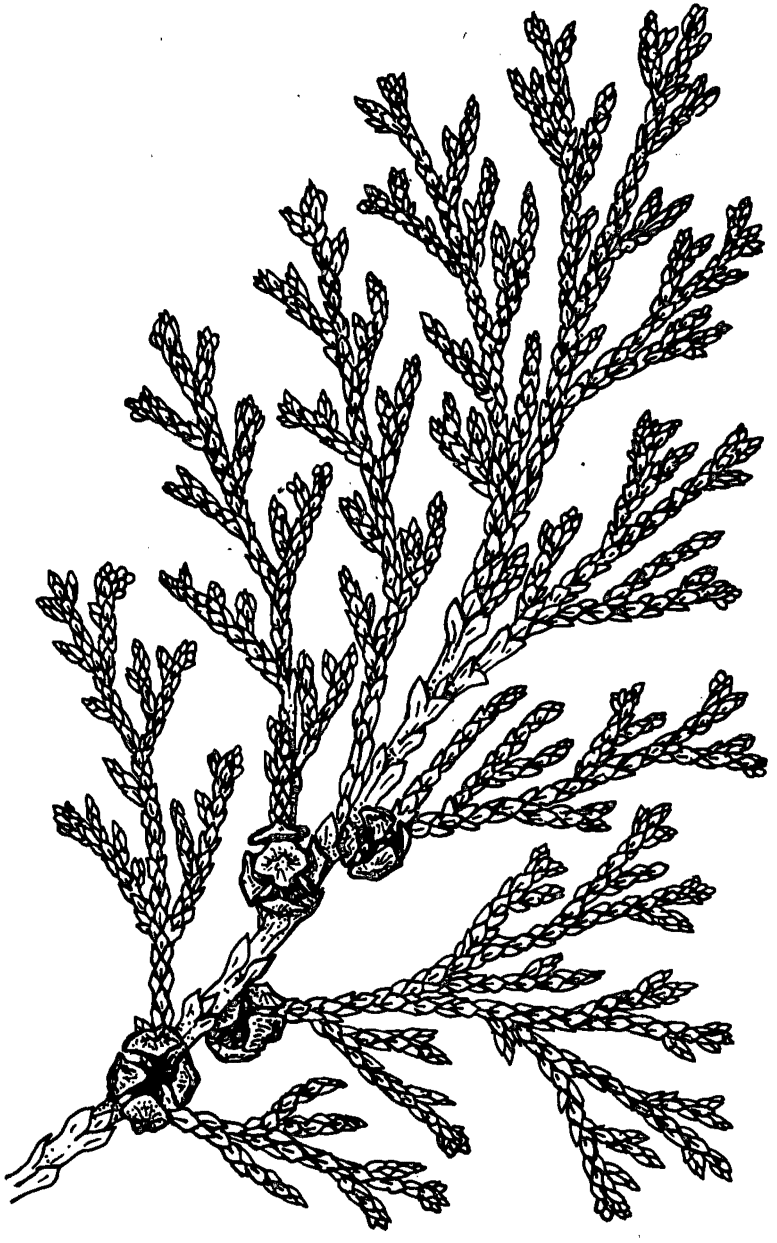
Management Implications

This type may have potential for selective cuts especially in older stands. The high volume of coarse fragments in the surface and subsurface of the soils, may reduce the regeneration potential of these sites. The higher moisture at these sites may modify the effect of the low available nutrient content found in most serpentine soils.

Closely Related Types

This type may be replaced on slightly drier sites by Douglas-fir/Huckleberry oak. Closer to the coast it may be replaced by Douglas-fir/Huckleberry oak-Dwarf tanbark. The dwarf tanbark type lacks the presence of Pacific rhododendron.

Port Orford Cedar Series



INTRODUCTION TO THE PORT ORFORD CEDAR SERIES

The portion of the Port Orford cedar series found on serpentine soils was described using 99 ecology plots in Del Norte, Siskiyou, and Humboldt Counties. The highest frequency of plots were sampled in Del Norte County, where the greatest extent of serpentine soils were found (figure1). Second in number of plots was the Orleans Ranger District in Humboldt County, followed by the Happy Camp and Ukonom Ranger Districts in Siskiyou County, and the Lower Trinity Ranger District in Humboldt County.

Analysis of the sample data identified five subseries, containing eight plant associations in the Port Orford cedar series (Table 7). The highest number of plant associations were identified on the Ukonom and Orleans Ranger Districts (6), followed by the Happy Camp Ranger District (5), and Gasquet Ranger District (4).

The plant associations of the Port Orford cedar series were arrayed along elevation/moisture/parent material gradients (figure 14) and differed from one another by elevation, subsurface pH, available water holding capacity, and aspect. Elevation ranged from 1500 to 5180 feet and influenced soil temperature and the length of the growing season. Sites were mostly low in surface rock, found in moist lower one-third slope and streamside positions, with low to high AWC, and variable aspects moderated by topographic shading particularly in southerly aspects. Parent material was peridotite and serpentinite with varying degrees of serpentinization which was reflected in soil pH. Mean surface and subsurface pH ranged from 6.0 to 7.2 and were indicators of parent material origin and soil development.

Plant associations in the Port Orford cedar series were arranged along the environment gradients described above as follows. The Port Orford cedar-Western White Pine/Huckleberry Oak type was found on the lowest elevation, mesic sites (figure 14). Streamside positions contained Port Orford cedar/Western Azalea, while slightly drier sites were dominated by the Port Orford cedar/Pacific Rhododendron-Salal type, and on sites disturbed by landslides the Port Orford cedar-Incense cedar-White Alder type. They were followed on mid elevation, warm sites by the Port Orford cedar-Douglas-fir/Huckleberry Oak type. On higher elevation, cool, streamside sites we found the Port Orford cedar-White Fir/Western Azalea type, while drier/warmer sites contained the Port Orford cedar-White Fir/Huckleberry Oak type. The highest elevation, cold sites contained the Port Orford cedar-White Fir-Western White Pine/Huckleberry Oak type.

Stand structure in the Port Orford cedar series points toward the importance of water as the limiting factor to tree growth in northwest California. Plant association here had taller and larger trees than any other plant association on serpentine soils as a result of soil moisture and topographic position. The Port Orford cedar-Incense cedar-White Alder type had the tallest mean tree height in the top layer with a mean of 158 feet. While the Port Orford cedar/Pacific Rhododendron-Salal type had the largest mean diameter in the top layer 46 inches dbh and second largest diameter in the second layer 33 inches dbh. In contrast, the Port Orford cedar-Western White Pine/Huckleberry Oak type had the shortest mean tree height of 97 feet in the top layer and smallest mean diameter of 29 inches dbh, as well as the shortest mean height of 79 feet in the second layer.

Vegetation composition reflects the variable environments described above. For

Table 7. Plant associations found in the Port Orford cedar series on serpentine soils.

EDP CODE	PLANT ASSOCIATION NAME
CHLA Shrub Subseries	Port Orford cedar/Shrub
CHLA/RHMA-GASH	Port Orford cedar/Pacific Rhododendron/ Salal
CHLA/RHOC	Port Orford cedar/Western Azalea
CHLA-ABCO Subseries	Port Orford cedar-White Fir
CHLA-ABCO/QUVA	Port Orford cedar-White Fir/ Huckleberry Oak
CHLA-ABCO-PIMO3/QUVA	Port Orford cedar-White Fir-Western White Pine/Huckleberry Oak
CHLA-ABCO/RHOC	Port Orford cedar-White Fir/Western Azalea
CHLA-PSME Subseries	Port Orford cedar-Douglas-fir
CHLA-PSME/QUVA	Port Orford cedar-Douglas-fir/Huckleberry Oak
CHLA-PIMO3 Subseries	Port Orford cedar-Western White Pine
CHLA-PIMO3/QUVA	Port Orford cedar-Western White Pine/ Huckleberry Oak
CHLA-CADE3 Subseries	Port Orford cedar-Incense Cedar
CHLA-CADE3-ALRH	Port Orford cedar-Incense Cedar-White Alder

instance, the Port Orford cedar-White Fir subseries was found on high elevation cool sites. White fir was the indicator species that identifies this high elevation subseries. Within the subseries on wet sites adjacent to streams western azalea was the indicator species. On warmer, drier sites huckleberry oak dominates, while on the highest elevation cool sites western white pine was the indicator species. This group of indicator species was also present in the mid and low elevation sites. The only change here was with western white pine and Pacific rhododendron. Western white pine successfully competes here due to its close proximity to the Pacific Ocean where coastal fog and concave slope micro-position influence air temperature. Pacific rhododendron was an additional moist indicator species that was often found just upslope from western azalea on slightly drier sites.

Age class distribution in the Port Orford cedar series was shifted towards older stands indicating a low frequency of disturbance. For instance, the youngest type in the Port Orford cedar series (215 years) was the Port Orford cedar-Incense Cedar-White Alder type. Disturbance in this type was mainly related to landslides resulting from flooding. The rest of the Port Orford cedar types range in mean stand age from 344 to 421 years. They were mainly disrupted by infrequent stand replacing fires. When the Port Orford cedar series was compared to other upland forest types it was found to have the highest mean stand age of all forest vegetation series in northwest California (Jimerson 1995).

Recent disturbance events were primarily related to Port Orford cedar root

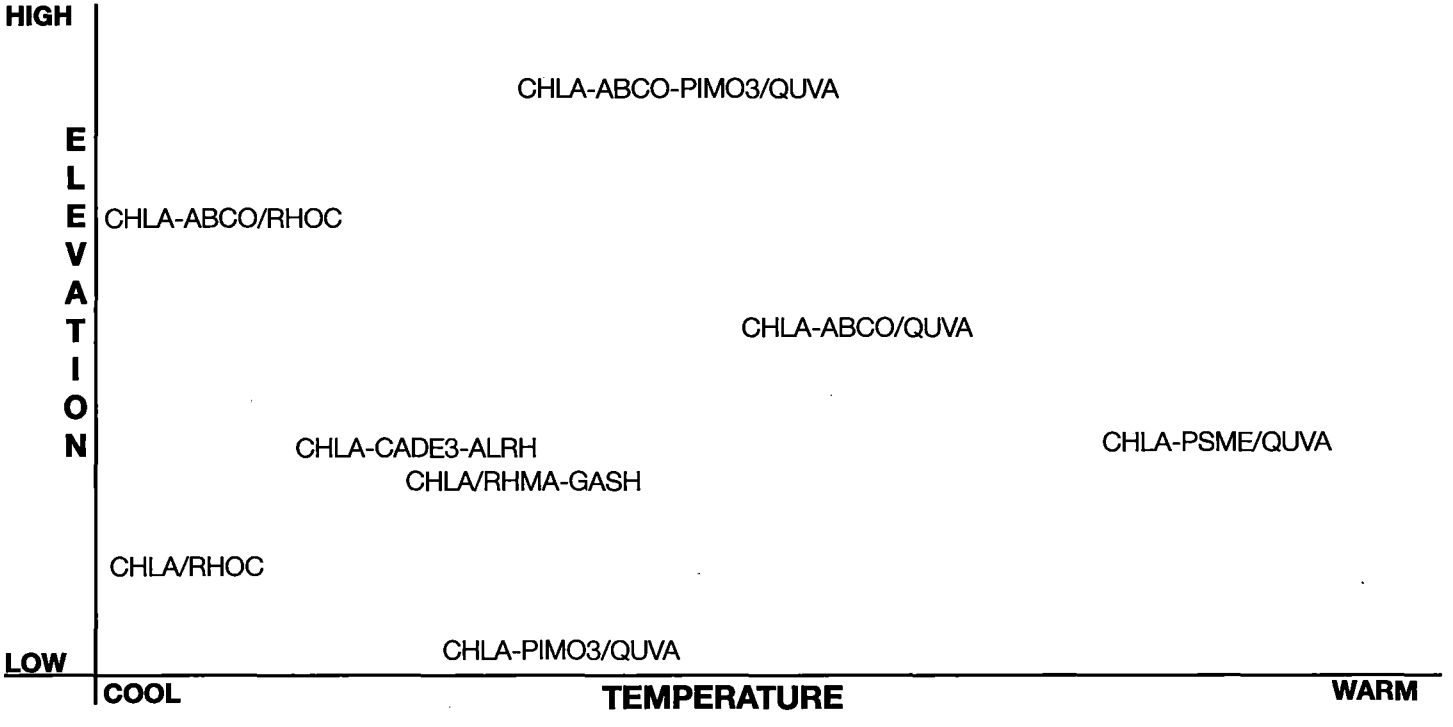


FIGURE 14 . Relative relationships of plant association in the Port Orford Cedar series based on elevation and temperature.

disease. This disease results in the death of individual trees and was particularly prevalent in streamside Port Orford cedar plant associations. Please be aware that the disease was mainly spread by humans. If you plan to visit areas containing Port Orford cedar please read the resource protection alert included in the introduction (page A-19).

The Port Orford cedar series included the sensitive plants, Siskiyou indian paintbrush (*Castilleja miniata* ssp. *elata*) and great burnet (*Sanguisorba officianalis*) along with the rare plants, California pitcher plant, butterwort (*Pinguicula vulgaris* ssp. *macroceras*), Del Norte willow (*Salix delnortensis*), California lady's-slipper (*Cypripedium californicum*), and yellow inside-out flower (*Vancouveria chrysantha*).

Port Orford Cedar Series Key

1 a. White fir cover ≥ 5% 2

2 a. Western white pine cover ≥ 5% CHLA-ABCO-PIMO3/QUVA

2 b. Western white pine absent or not as above 3

3 a. Western azalea cover ≥ 10% ..... CHLA-ABCO/RHOC

3 b. Western azalea absent or not as above 4

4 a. Huckleberry oak cover ≥ 5% . CHLA-ABCO/QUVA

4 b. Huckleberry oak absent or not as above 5

1 b. White fir absent or not as above 5

5 a. Huckleberry oak cover ≥ 5% 6

6 a. Western white pine present in overstory and understory CHLA-PIMO3/QUVA

6 b. Western white pine absent or not as above ..... CHLA-PSME/QUVA

5 b. Huckleberry oak absent or not as above7

7a. Salal cover ≥ 10% 8

8a. Pacific rhododendron cover ≥ 10% ..... CHLA/RHMA-GASH

8b. Pacific rhododendron absent or not as above 9

9a. Western azalea cover ≥ 10% ..... CHLA/RHOC

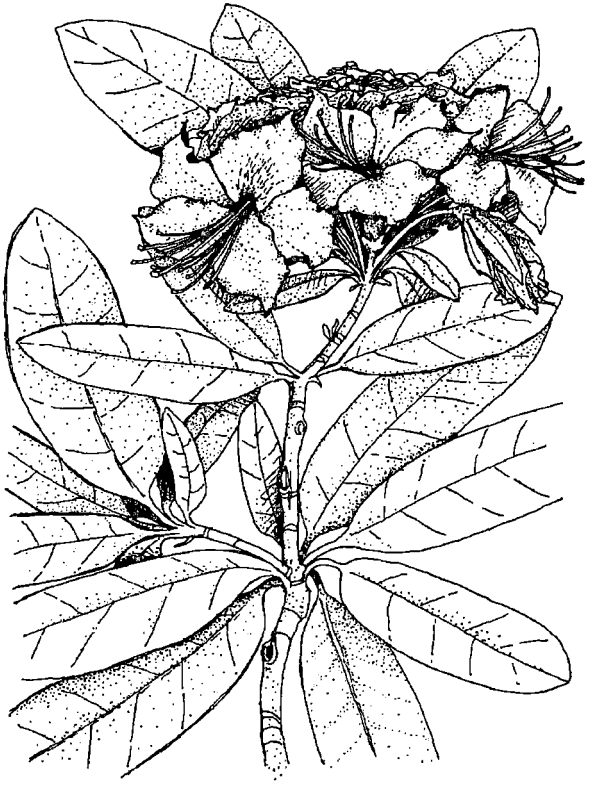
9b. Western azalea absent or not as above .....Return to step 1 and try the key again

7b. Salal absent or not as above 10

10a. Incense cedar and alder present CHLA-CADE3-ALRH

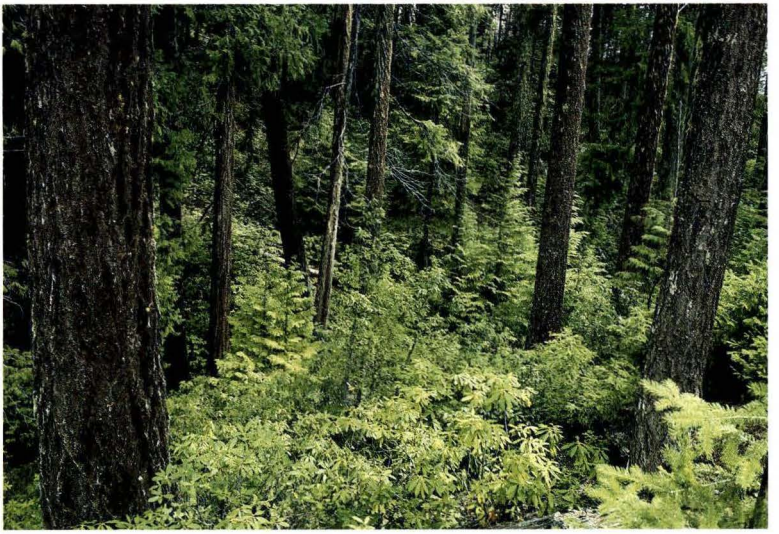
10b. Western azalea cover ≥ 10% .. CHLA/RHOC

Port Orford Cedar/Pacific Rhododendron-Salal CHLA/RHMA-GASH EcoCode CCOCCO12



Pacific rhododendron
(Rhododendron macrophyllum)

Port Orford Cedar/Pacific Rhododendron-Salal CHLA/RHMA-GASH, EcoCode CCOCCO12



SUMMARY TABLE

(Sample size: 18)		COVER	CON
Tree Overstory Layer			
CHLA	Port Orford Cedar	44	100
PSME	Douglas-fir	32	100
CACH2	Chinquapin	8	66
Tree Understory Layer			
CHLA	Port Orford Cedar	4	100
LIDE2	Tanoak	2	55
CACH2	Chinquapin	3	50
Shrubs			
RHMA	Pacific Rhododendron	35	100
GASH	Salal	36	94
VAPA	Red Huckleberry	2	100
Herbs & Grasses			
XETE	Beargrass	3	83
GOOB	Rattlesnake Plantain	1	77
LIBOL	Twinflower	3	66
CHUMO	Pipsissewa	3	55

Environment

Elevation: 2700-3600 ft.

Aspect: N.W., N.E.

Slope: 10-60%

Slope Position: lower and middle 1/3

Surface Rock: 0-7%

Soils

Pit Depth: 22-40"+

Coarse Fragments: 15-45%

Textures: gl,vgl,vgcl

Parent Material: phyllite, mafic, greenstone, & serpentinite

Distribution/Environment

This type was found on the Gasquet and Orleans ranger districts in lower and middle one-third slope positions with undulating, concave and linear micro-relief. Elevation averaged 3269 feet and ranged from 2700 to 3600 feet, on gentle (32%) slopes with northwest and northeast facing aspects. Radiation index was the lowest in the Port Orford cedar series (.376) as a result of north aspects.

Soil Summary

Soils in this type were well drained, primarily derived from the fine textured metamorphic parent materials phyllite, mafic, greenstone, and serpentinite. These rocks imparted a moderately acidic surface pH (6.0) and a slightly acid subsurface pH (6.2). These soils were deep (61%) and moderately deep (39%), gravelly to very gravelly loams, with moderate to high AWC (3.9"), moderately thick A horizons (5"), and low A horizon coarse fragments (32%). They were found in the mesic and frigid soil temperature regimes and were highly productive for conifer growth. The dominant soil families were fine loamy or loamy skeletal, mixed, Dystric or Typic Xerochrepts (72%) and fine loamy, mixed, Typic Haploxerults (17%).

Vegetation Summary

Total vegetation cover was very dense (98%), while overstory cover of 79 percent was moderate. Overstory conifer species included Port Orford cedar (44%), which was codominant with Douglas-fir (32%). Hardwood cover values in the mid layer were low with chinquapin (8%) as the prominent species. The tree regeneration layer was dominated by Port Orford cedar (4%), with chinquapin (3%), tanoak (2%), and Douglas-fir (1%) as occasional associates. The shrub layer averaged 70 percent cover, which was the highest in the Port-Orford cedar series. Pacific rhododendron (35%) and salal (36%) share dominance, with red huckleberry (2%), and dwarf Oregon-grape (3%) as associates. Total forb cover (8%) was moderate; it included beargrass (3%), twinflower (3%), prince's pine (3%), rattlesnake plantain (1%), and twinflower (1%).

Disturbance and Age Class Distribution

Stands in this type had a relatively balanced age class distribution. They ranged in age from 137 to 710 years with an average of 349 years, among the oldest in the Port Orford cedar series. The highest frequency of stands (56%) was found in stands greater than 376 years of age. The frequency of stands above 300 years was 56 percent; the frequency of stands below 200 years was 11 percent. This dominance by older age stands indicates the low frequency of stand replacing fires that occur in this type.

Stand Structure Summary

Stands in this type had a mixture of tolerant and moderately intolerant conifers in the dense overstory; occasional high cover of hardwoods was found in the mid layer, along with a variety of diameter classes which resulted in multiple layered stands. The overstory was usually composed of at least two layers of different aged conifers, averaging 155 feet tall and 46 inches in diameter in the top layer and 115 feet tall and 33 inches in diameter in the second layer. It had a high density of large conifers greater than 30 inches diameter, with an average of 25 trees/acre. The mid layers were often dominated by hardwood species, they ranged from 25 to 70 feet tall. Most hardwood species were found in the smaller diameter classes with an average of 15 trees/acre in the 6 to 10.9 inch diameter class. The regeneration layer had a high density of conifers.

Softwood cubic volumes were high with an average of 12,498 ft3/acre. Hardwood cubic volume of 156 ft3/acre was low. Dunning site class was 1, with site index of

175 at 300 years. Stand density index was high with an average of 490.

Successional Trends

The Port Orford cedar/Pacific Rhododendron-Salal type has a low potential for alteration of its successional pathway with continued fir suppression. This is due to the mesic nature of this type related to its position just upslope from perennial streams. Moisture conditions and cold air flow favor Port Orford cedar regeneration. Fires of low intensity are the primary disturbance events, with occasional high intensity events during dry periods related to the high shrub cover.

The main threat to successional pathway alteration in this type is Port Orford cedar root disease. The risk of Port Orford cedar root disease is high in this type due to its streamside position and high density of Port Orford cedar trees.

Rare Plant Relationships

No rare or sensitive plants have been identified in this type to date.

Management Implications

The major limitations for management in this type are related to disease, soils, and shrub composition. The threat of introduction of Port Orford cedar root disease needs to be considered in any proposed management activities. The major management limitation for these soils is susceptibility to compaction when soils are moist. Competition from shrubs such as Pacific Rhododendron can be limiting factor to successful regeneration.

Closely Related Types

The Port Orford cedar/Pacific Rhododendron-Salal type is often located just upslope from the Port Orford cedar/Western Azalea type found in streamside positions. They differ in the lower radiation index, higher site class, and presence of Pacific rhododendron in the Port Orford cedar/Pacific Rhododendron-Salal type.

Port Orford Cedar/Western Azalea
CHLA/RHOC
EcoCode CCOCCO13

western azalea
(Rhododendron occidentale)

Port Orford Cedar/Western Azalea
CHLA/RHOC Association, EcoCode CCOCCO13

SUMMARY TABLE

(Sample size: 13)		COVER	CON
Tree Overstory Layer			
CHLA	Port Orford Cedar	42	100
PSME	Douglas-fir	24	100
PILA	Sugar Pine	4	61
Tree Understory Layer			
CHLA	Port Orford Cedar	9	100
LIDE2	Tanoak	2	69
PSME	Douglas-fir	2	53
Shrubs			
RHOC	Western Azalea	24	100
VAPA	Red Huckleberry	2	76
RUUR	Pacific blackberry	1	76
Herbs & Grasses			
XETE	Beargrass	2	76
GOOB	Rattlesnake Plantain	1	69
CAR1	Sedge	2	61

Environment

Elevation: 2500-3940 ft.

Aspect: N.E.

Slope: 5-45%

Slope Position: lower and middle 1/3

Surface Rock: 0-6%

Soils

Pit Depth: 33-40"+

Coarse Fragments: 10-35%

Textures: l, gl, vgl

Parent Material: serpentinite, peridotite, gneiss, & sandstone

Distribution/Environment

This type was found on the Orleans, Ukonom, and Happy Camp ranger districts in the lower and middle one-third slope positions with undulating, linear micro-relief. Elevation averaged 3143 feet and ranged from 2500 to 3940 feet, on gentle (21%) slopes with northeast facing aspects. Radiation index was moderate (.453), but was partially offset by a high water table and topographic shading.

Soil Summary

Soils in this type were primarily well drained, derived from fine textured metamorphic parent materials including peridotite, gneiss, and serpentinite, with occasional coarse textures derived from sandstone. These rocks imparted a neutral surface pH (6.8) and a slightly alkaline subsurface pH (7.4). They were deep (75%) and moderately deep (25%), loamy to very gravelly loams, with high AWC (5.4"), moderately thick A horizons (5"), and low A horizon coarse fragments (25%). They were found in the mesic and frigid soil temperature regimes and were of low to moderate productivity for conifer growth. The dominant soil families fine loamy and loamy skeletal, mixed, Typic or Dystric Xerochrepts (54%), fine loamy serpentinitic, Typic Haploxeralfs (16%), and fine loamy, mixed, Typic Haploxerults.

Vegetation Summary

Total vegetation cover was dense (95%), and overstory cover of 77 percent was moderate. Overstory conifer species included Port Orford cedar (42%), with Douglas-fir (24%) and sugar pine (4%) as associate species. Hardwood cover values in the mid layer were low, with tanoak (9%) as an occasional member. The tree regeneration layer was dominated by Port Orford cedar (9%) with tanoak (2%) as an occasional associate. The shrub layer averaged 38 percent cover, which was moderate for the Port Orford cedar series. Western azalea (24%) dominated here followed by salal (12%), huckleberry oak (4%), red huckleberry (2%), and Pacific blackberry (1%). Total forb cover (6%) was moderate; it included beargrass (2%), rattlesnake plantain (1%), twinflower (1%), and prince's pine (1%). Sedges (2%) were the dominant species in the grass layer.

Disturbance and Age Class Distribution

Stands in this type had their age class distribution dominated by stands greater than 300 years old. They ranged in age from 300 to 641 years with an average of 420 years, among the oldest in the Port Orford cedar series. The highest frequency of stands (66%) were found between 300 and 425 years of age. The frequency of stands above 300 years was 100 percent; the frequency of stands below 200 years was 0 percent. This dominance by older age stands indicates the low frequency of stand replacing fires that occur in this type.

Stand Structure Summary

Stands in this type had a mixture of tolerant and moderately intolerant conifers in the moderately dense overstory, occasional high cover of hardwoods were found in the mid layer. A variety of diameter classes were present, which resulted in multiple layers. The overstory was usually composed of at least two layers of different aged conifers, averaging 143 feet tall and 40 inches in diameter in the top layer and 108 feet tall and 27 inches in diameter in the second layer. It had a high density of large conifers, with an average of 22 trees/acre greater than 30 inches diameter. The mid layers were often dominated by hardwood species; they ranged from 25 to 70 feet tall. Most hardwood species were found in the smaller diameter classes with an average of 19 trees/acre in the 6 to 10.9 inch diameter class. The regeneration layer was low due to a high density of small and intermediate conifers and hardwoods.

Softwood cubic volumes ranged from low to moderate with an average of 10,751 ft3./acre. Hardwood cubic volume of 56 ft3/acre was low. Dunning site class was 3, with site index of 125 at 300 years. Stand density index was high with an average of 498.

Successional Trends

The Port Orford cedar/Western Azalea type has a low potential for alteration of its successional pathway with continued fire suppression. This is due to the wet nature of this type related to its streamside position adjacent to perennial streams. Moisture conditions favor Port Orford cedar regeneration. Flooding and fires of low intensity are the primary disturbance events, with occasional high intensity events during dry periods related to the high shrub cover.

The main threats to successional pathway alteration in this type are Port Orford cedar root disease and white pine blister rust. The risk of Port Orford cedar root disease is high in this type due to its streamside position and high density of Port Orford cedar trees. White pine blister rust could significantly alter species composition by eliminating sugar pine as a component and favoring other species such as Douglas-fir.

Rare Plant Relationships

The sensitive plants Siskiyou indian paintbrush and great burnet along with the rare plants California pitcher plant, butterwort, Del Norte willow, California lady's-slipper, and yellow inside-out flower were identified in this type.

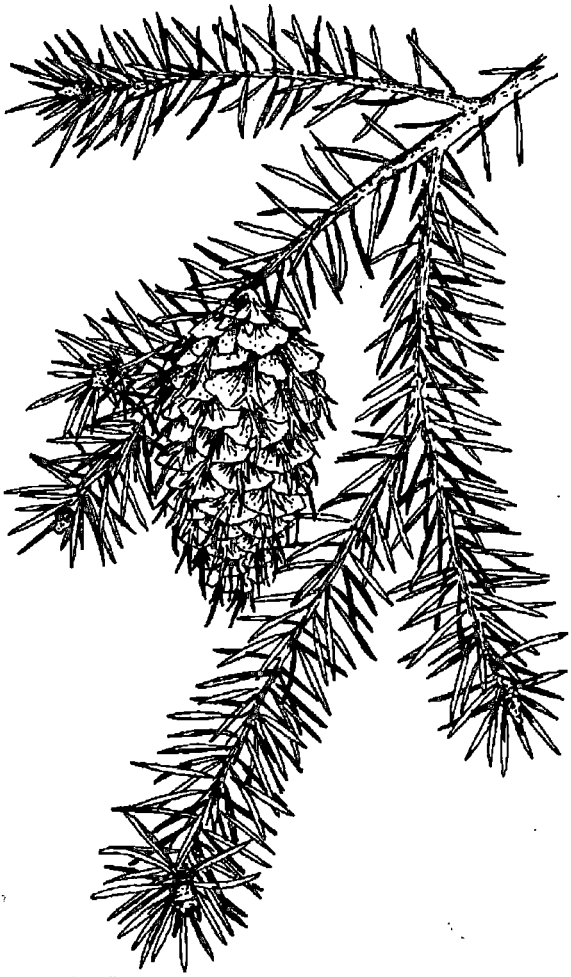
Management Implications

The major limitations for management in this type are related to disease and soils. The threat of introducing of Port Orford cedar root disease needs to be considered in any proposed management activities. The potential for white pine blister rust can be assessed based on the presence of the primary host species (western white pine or sugar pine and gooseberry). Limitations for management are mainly associated with fertility imbalances due to the ultramafic parent material.

Closely Related Types

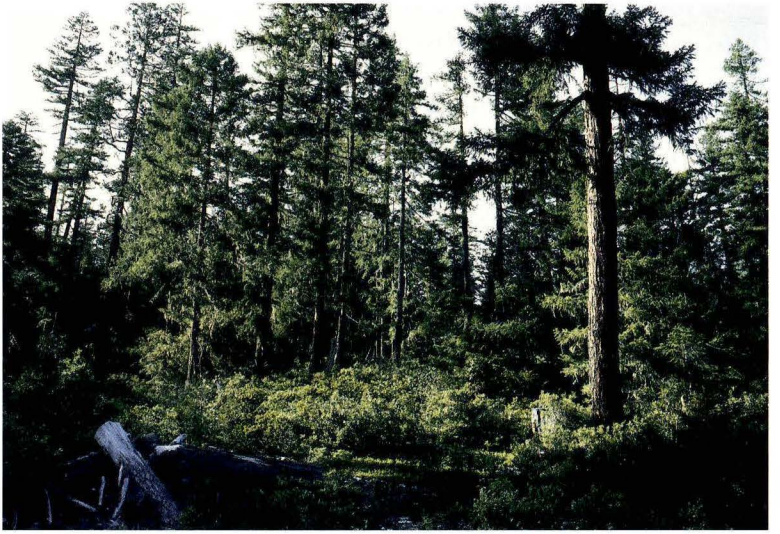
The Port Orford cedar/Western Azalea type is the lower elevation expression of the Port Orford cedar-White Fir/Western Azalea type. They differ in elevation, the presence of white fir and the lower degree of serpentinization found in the Port Orford cedar-White Fir/Western Azalea type.

Port Orford Cedar-Douglas Fir/
Huckleberry Oak
CHLA-PSME/QUVA
EcoCode CCOCFW17



Douglas-fir
(Pseudotsuga menziesii)

Port Orford Cedar-Douglas Fir/Huckleberry Oak CHLA-PSME/QUVA Association, EcoCode CCOCFW17



SUMMARY TABLE

(Sample size: 22)		COVER	CON
Tree Overstory Layer			
CHLA	Port Orford Cedar	28	100
PSME	Douglas-fir	26	100
PILA	Sugar Pine	7	86
Tree Understory Layer			
CHLA	Port Orford Cedar	3	100
PSME	Douglas-fir	1	72
LIDE2	Tanoak	5	54
PILA	Sugar Pine	1	45
Shrubs			
QUVA	Huckleberry Oak	23	100
VAPA	Red Huckleberry	5	81
Herbs & Grasses			
XETE	Beargrass	3	77
GOOB	Rattlesnake Plantain	1	72
IRI	Iris	1	63
WHMO	Western Modesty	2	54

Environment

Elevation: 2520-3720 ft.

Aspect: N.W., E.

Slope: 0-70%

Slope Position: lower thru upper 1/3

Surface Rock: 1-10%

Soils

Pit Depth: 22-40"+

Coarse Fragments: 20-55%

Textures: gsil, gl, vgl

Parent Material: serpentinite, peridotite

Distribution/Environment

This type was found on the Gasquet, Orleans, Ukonom, and Happy Camp ranger districts in the upper, middle, and lower one-third slope positions with concave, undulating, and linear micro-relief. Elevation averaged 3425 feet and ranged from 2520 to 3720 feet, on gentle (30%) slopes with northwest and east facing aspects. Radiation index was moderate (.431) as a result of east aspects. This type appears to be the driest plant association in the Port Orford cedar series, with a surface rock average of 9 percent.

Soil Summary

Soils in this type were well drained, derived from the fine textured ultramafic parent materials peridotite and serpentinite. They imparted a neutral pH (6.8) at the surface and subsurface (7.2). They were moderately deep (50%), deep (45%) and shallow (5%), gravelly to very gravelly loams, with low to high AWC (3.3"), moderately thick A horizons (5"), and low to high A horizon coarse fragments (31%). They were found in the mesic and frigid soil temperature regimes and were of low to moderately productivity for conifer growth. The dominant soil families were loamy skeletal, mixed or serpentinitic, Typic or Dystric Xerochrepts (86%) and fine loamy, mixed, Typic Haploxerults (9%).

Vegetation Summary

Total vegetation cover was moderate (91%), and overstory cover of 70 percent was second lowest in the Port-Orford cedar series. Overstory conifer dominance was shared between Port Orford cedar (28%) and Douglas-fir (26%), with sugar pine (7%) as an associate species. The tree regeneration layer was dominated by Port Orford cedar (3%), Douglas-fir (1%), and tanoak (5%) in shrub form. The shrub layer averaged 33 percent cover, which was moderate for the Port-Orford cedar series. Huckleberry oak (23%) dominated here, followed by red huckleberry (5%), and wild rose (1%). Total forb cover (9%) was moderate; it included beargrass (3%), western modesty (2%), rattlesnake plantain (1%), iris (1%), prince's pine (1%), and starflower (1%).

Disturbance and Age Class Distribution

Stands in this type had a balanced age class distribution with stands included in most age class categories. They ranged in age from 129 to 666 years with an average of 391 years, among the oldest in the Port Orford cedar series. The frequency of stands above 300 years was 73 percent; the frequency of stands below 200 years was 9 percent. This shift towards at least some stands in the younger age categories indicates the slightly higher frequency of stand replacing fires that occur in this type.

Stand Structure Summary

Stands in this type had a mixture of tolerant and moderately intolerant conifers in the moderate overstory, along with a variety of diameter classes which resulted in multiple layers. The overstory was usually composed of at least two layers of different aged conifers, averaging 134 feet tall and 39 inches in diameter in the top layer and 105 feet tall and 26 inches in diameter in the second layer. It had a high density of large conifers, with an average of 22 trees/acre greater than 30 inches diameter. The mid layers were dominated by conifer species, they ranged from 25 to 50 feet tall. The regeneration layer was sparse due to a dense shrub layer.

Softwood cubic volumes ranged from low to moderate with an average of 9,821 ft3/acre. Dunning site class was 2, with site index of 150 at 300 years. Stand density index was moderate with an average of 454.

Successional Trends

The Port Orford cedar-Douglas-fir/Huckleberry Oak type has a low potential for alteration of its successional pathway with continued fir suppression. This is due to the mesic nature of this type. Moisture conditions favor Port Orford cedar and Douglas-fir regeneration. Fires of low intensity are the primary disturbance events, with occasional high intensity events during dry periods related to the high shrub cover.

The main threats to successional pathway alteration in this type are Port Orford cedar root disease and white pine blister rust. The risk of Port Orford cedar root disease is low in this type due to its upslope position and low density of Port Orford cedar trees. White pine blister rust could alter species composition by eliminating sugar pine and favor other species such as Douglas-fir.

Rare Plant Relationships

No rare or sensitive plants have been identified in this type to date.

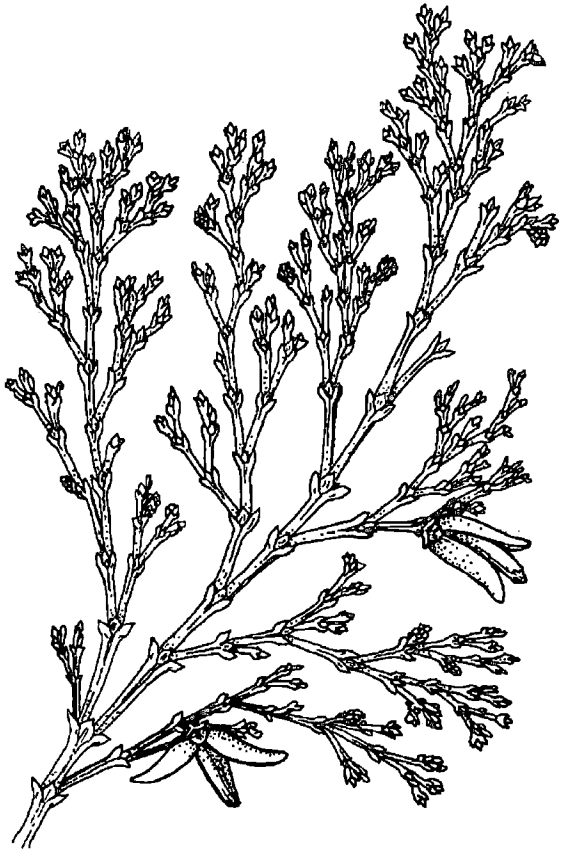
Management Implications

The major limitations for management in this type are related to disease and soils. The threat of introduction of Port Orford cedar root disease needs to be considered in any proposed management activities. The potential for white pine blister rust can be assessed based on the presence of the primary host species (western white pine or sugar pine and gooseberry). The major limitations for these soils are fertility imbalances due to the ultramafic parent material, low plantability in areas with high surface rock, areas of high soil coarse fragments, areas of steep slopes, potentially high erodibility, susceptibility to burning damage, and susceptibility to compaction when soils are moist.

Closely Related Types

The Port Orford cedar-Douglas-fir/Huckleberry Oak type is often located just upslope from the Port Orford cedar-Western White Pine/Huckleberry Oak type found in concave slope shapes and draws. They differ in air flow and temperature, and productivity.

Port Orford Cedar-Incense Cedar-White Alder
CHLA-CADE3/ALRH
EcoCode CCOCFW18



incense cedar
(Libocedrus decurrens)

Port Orford Cedar-Incense Cedar-White Alder
CHLA-CADE3/ALRH Association, EcoCode CCOCFW18

SUMMARY TABLE

(Sample size: 3)		COVER	CON
Tree Overstory Layer			
CHLA	Port Orford Cedar	35	100
PSME	Douglas-fir	30	100
CADE3	Incense Cedar	9	100
ALRH	White Alder	5	100
ACMA	Big Leaf Maple	5	50
Tree Understory Layer			
CHLA	Port Orford Cedar	4	100
CADE3	Incense Cedar	2	66
ALRH	White Alder	3	66
PSME	Douglas-fir	5	66
LIDE2	Tanoak	3	66
ACMA	Big Leaf Maple	3	66
Shrubs			
RUUR	Pacific blackberry	1	100
BENE1	Dwarf Oregongrape	3	66
Herbs & Grasses			
ACTR	Vanilla Leaf	1	100
LIBOL	Twinflower	2	66
POMU1	Sword Fern	2	66

Environment

Elevation: 3220-3390 ft.

Aspect: S.E..

Slope: 25-50%

Slope Position: lower & middle 1/3

Surface Rock: 2-5%

Soils

Pit Depth: 35-40"+

Coarse Fragments: 35-45%

Textures: vgl

Parent Material: schist, mixed

Distribution/Environment

This type was found only on the Ukonom Ranger District in the middle and lower one-third slope positions with undulating, convex micro-relief. Elevation averaged 3230 feet and ranged from 3100 to 3390 feet, on gentle (33%) slopes with southeast facing aspects. Radiation index was the highest in the Port Orford cedar series (.542) as a result of southeast aspects. This type tends to be dry as a result of aspect and convex micro-relief. The presence of incense cedar substantiates this drier environment.

Soil Summary

Soils in this type were well drained, derived from the fine textured metamorphic parent materials serpentinite, schist and mixed. These rocks imparted a slightly acidic surface pH (6.3) and a neutral subsurface pH (7.1). These soils were primarily deep (66%) and moderately deep (33%), very gravelly loams, with moderate AWC (3.3"), moderately thick A horizons (6"), and moderate A horizon coarse fragments (40%). They were found on old landslides in the frigid soil temperature regime and were moderately productive for conifer growth. The dominant soil family was loamy skeletal, mixed, Dystric Xerorthents.

Vegetation Summary

Total vegetation cover was very dense (94%), while the overstory cover of 92 percent was the highest in the Port-Orford cedar series. Overstory dominance was shared between Port Orford cedar (35%) and Douglas-fir (30%), with incense cedar (9%) and white alder (5%) as associate species. The tree regeneration layer was dominated by Port Orford cedar (4%), Douglas-fir (5%), and white alder (3%). The shrub layer averaged 9 percent cover, which was the lowest in the Port-Orford cedar series. Dwarf Oregon-grape (3%), along with Pacific blackberry (1%) and red huckleberry, were among the few shrubs present. Total forb cover (12%) was also the lowest value in the series. Forb species included vanilla leaf (1%), prince's pine (1%), twinflower (2%), starflower (1%), Hooker's fairybell (1%), western modesty (1%), swordfern (2%), inside-out flower (1%), and hawkweed (1%).

Disturbance and Age Class Distribution

Stands in this type had their age class distribution dominated by younger stands. Mean stand age was 215 years; lowest of all Port Orford cedar types. It ranged from 200 to 225 years stand age. The highest frequency of stands (100%) were found between 176 and 225 years of age. The frequency of stands above 300 years was 0 percent; the frequency of stands below 200 years was also 0 percent. This narrow age class distribution indicates that these stands were created at approximately the same time and due to their geomorphology probably resulted from flooding.

Stand Structure Summary

Stands in this type had a mixture of tolerant and moderately intolerant conifers in the moderately dense overstory, along with a variety of diameter classes which resulted in multiple layers. The overstory was usually composed of at least two layers of different aged conifers, averaging 158 feet tall and 42 inches in diameter in the top layer and 113 feet tall and 26 inches in diameter in the second layer. It had a moderate density of large conifers, with an average of 18 trees/acre greater than 30 inches diameter. The mid layers were dominated by conifer species; they ranged from 25 to 70 feet tall. The regeneration layer was low as a result of the dense overstory of trees.

Softwood cubic volumes were generally low with an average of 8,280 ft3/acre.

Dunning site class was 3, with site index of 125 at 300 years. Stand density index was moderate with an average of 459.

Successional Trends

The Port Orford cedar-Incense cedar-White Alder type has a low potential for alteration of its successional pathway with continued fir suppression. This is due to its streamside position adjacent to perennial streams. Moisture conditions and cold air flow favor Port Orford cedar regeneration. Flooding is the primary disturbance event here and is likely responsible for the stands we see today.

The main threat to successional pathway alteration in this type is Port Orford cedar root disease. The risk of Port Orford cedar root disease is high in this type due to its streamside position and high density of Port Orford cedar trees.

Rare Plant Relationships

No rare or sensitive plants have been identified in this type to date.

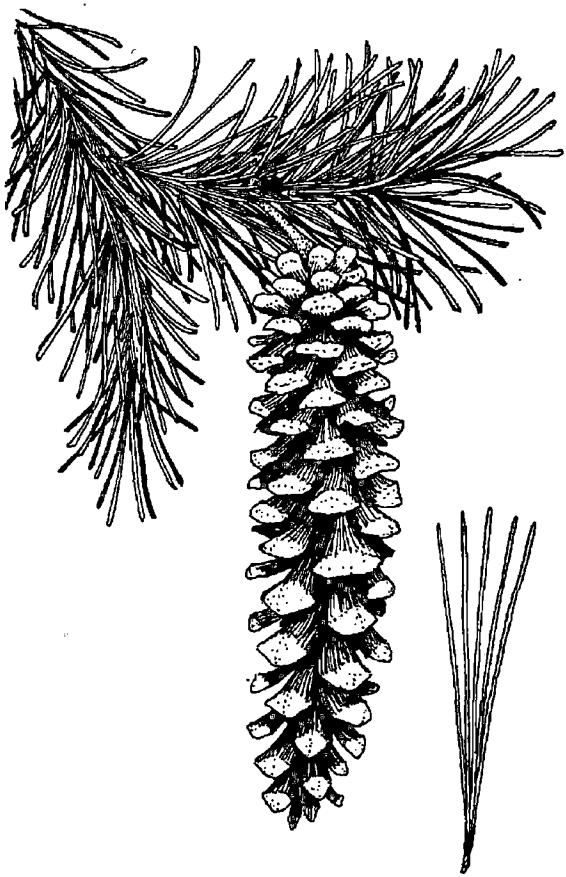
Management Implications

The major limitations for management in this type are related to disease and streamside positions. The threat of introduction of Port Orford cedar root disease needs to be considered in any proposed management activity in or adjacent to this type. Soils here are occasionally susceptible to compaction when moist.

Closely Related Types

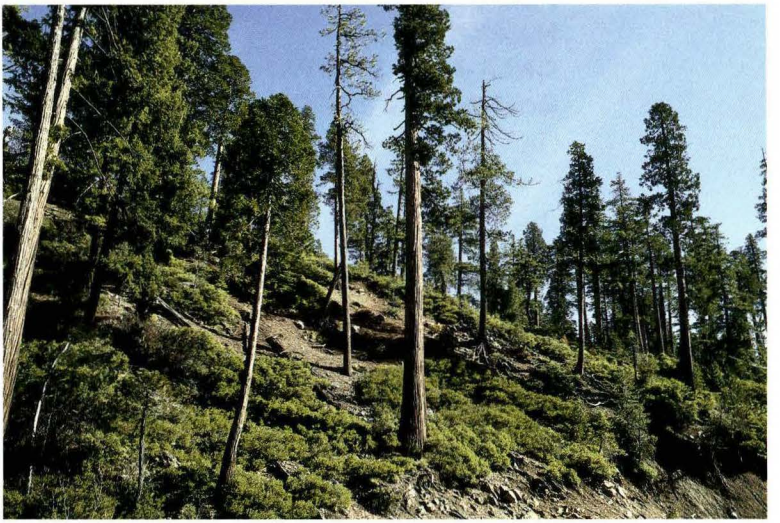
The Port Orford cedar-Incense Cedar-White Alder type is a higher elevation expression of the Tanoak-Port Orford cedar-Alder//Riparian type found on lower elevation streamside positions. They differ in their landform and frequency of floods.

Port Orford Cedar-Western White Pine/
Huckleberry Oak
CHLA-PIMO3/QUVA
EcoCode CCOCCO14



western white pine
(Pinus monticola)

Port Orford Cedar-Western White Pine/Huckleberry Oak CHLA-PIMO3/QUVA Association, EcoCode CCOCCO14



SUMMARY TABLE

(Sample size: 10)		COVER	CON
Tree Overstory Layer			
CHLA	Port Orford Cedar	28	100
PSME	Douglas-fir	14	100
PIMO3	Western White Pine	6	100
ARME3	Pacific Madrone	2	50
Tree Understory Layer			
PIMO3	Western White Pine	1	100
CHLA	Port Orford Cedar	3	90
PSME	Douglas-fir	2	80
Shrubs			
QUVA	Huckleberry Oak	38	100
VAPA	Red Huckleberry	6	80
LIDEE	Dwarf Tanbark	13	60
GABU2	Boxleaf Maple	1	50
RHOC	Western Azalea	12	60
Herbs & Grasses			
IRI	Iris	2	100
XETE	Beargrass	3	80
WHMO	Western Modesty	5	70
POMU1	Sword Fern	2	60

Environment

Elevation: 1500-3840 ft.

Aspect: E.,W.

Slope: 10-50%

Slope Position: lower & middle 1/3

Surface Rock: 4-25%

Soils

Pit Depth: 15-40"+

Coarse Fragments: 30-90%

Textures: xgl, vgl, gsl

Parent Material: serpentinite & peridotite

Distribution/Environment

This type was found only on the Gasquet Ranger District on cool, coastal sites subject to heavy winter snow packs. It was most often found in the middle and lower one-third slope positions with linear, undulating, and concave micro-relief. Elevation was the lowest in the Port Orford cedar series, with an average of 2884 feet. Elevation ranged from 1500 to 3840 feet, on gentle (33%) slopes with east and west facing aspects. Radiation index was among the highest in the Port Orford cedar series (.450) as a result of west aspects. Surface rock here was the highest in the series with an average of 14 percent cover.

Soil Summary

Soils in this type were well drained, derived from the fine textured ultramafic parent materials, peridotite and serpentinite. These soils had a slightly acidic surface pH (6.5) and a neutral subsurface pH (6.9). They were moderately deep (56%), shallow (33%) and deep (11%), very gravelly to extremely gravelly loams, with low AWC (1.8"), moderately thick A horizons (5"), and very high A horizon coarse fragments (62%). They were found in the mesic and frigid soil temperature regimes and were of low productivity for conifer growth. The dominant soil families were loamy skeletal, serpentinitic, Typic Xerochrepts (50%), loamy skeletal, serpentinitic, Lithic Xerochrepts (20%); and loamy skeletal, serpentinitic, Ultic Haploxeralfs (20%).

Vegetation Summary

Total vegetation cover was dense (93%), and overstory cover of 55 percent was the lowest of all Port-Orford cedar plant associations due to the high frequency of surface and subsurface rock. Port Orford cedar (28%) was the dominant overstory species, with Douglas-fir (14%) and western white pine (6%) as associates. The tree regeneration layer was dominated by Port Orford cedar (3%), Douglas-fir (2%), and western white pine (1%), with California bay (7%) in shrub form. The shrub layer averaged 66 percent cover, highest in the Port-Orford cedar series. Huckleberry oak (38%) dominated here followed by dwarf tanbark (13%), and red huckleberry (6%). Total forb cover (14%) was moderate; it included western modesty (5%), twinflower (3%), beargrass (3%), swordfern (2%), Prince's pine (2%), and iris (2%). Sedges (4%) dominated the grass layer.

Disturbance and Age Class Distribution

Stands in this type had their age class distribution dominated by stands greater than 300 years old. They ranged in age from 288 to 700 years with an average of 421 years, the oldest in the Port Orford cedar series. The highest frequency of stands (56%) were found between 276 and 375 years of age. The frequency of stands above 300 years was 95 percent; the frequency of stands below 200 years was 0 percent. This dominance by older age stands indicates the low frequency of stand replacing fires that occur in this type.

Stand Structure Summary

Stands in this type had a mixture of tolerant, moderately intolerant, and intolerant conifers in the open overstory, along with a variety of diameter classes which resulted in multiple layers. The overstory was usually composed of at least two layers of different aged conifers, averaging 97 feet tall and 29 inches in diameter in the top layer and 79 feet tall and 26 inches diameter in the second layer. It had a low density of large conifers, with an average of 7 trees/acre greater than 30 inches diameter. The mid layers were dominated by conifer species; they ranged from 15 to 35 feet tall. The regeneration layer was moderate due to a dense shrub layer.

Softwood cubic volumes were the lowest of all Port Orford cedar types with an

average of 6,374 ft3/acre. Dunning site class was 5, with site index of 75 at 300 years. Stand density index was the lowest of all Port Orford cedar types with an average of 404.

Successional Trends

The Port Orford cedar-Western White Pine/Huckleberry Oak type has a low potential for alteration of its successional pathway with continued fir suppression. This is due to the mesic nature of this type related to its position just upslope from perennial streams. Moisture conditions and cold air flow favor Port Orford cedar and western white pine regeneration. Fires of low intensity are the primary disturbance events, with occasional high intensity events during dry periods related to the high shrub cover.

The main threats to successional pathway alteration in this type are Port Orford cedar root disease and white pine blister rust. The risk of Port Orford cedar root disease is low in this type due to its upslope position and low density of Port Orford cedar trees. White pine blister rust could significantly alter species composition and favor other species such as Douglas-fir.

Rare Plant Relationships

The sensitive plant species, Siskiyou indian paintbrush, was identified in this type.

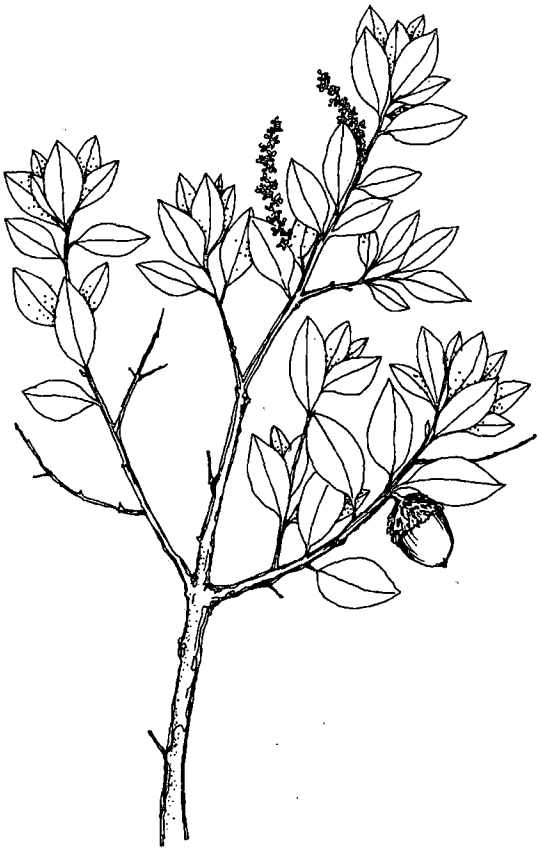
Management Implications

The major limitations for management in this type are related to disease and soils. The threat of introduction of Port Orford cedar root disease needs to be considered in any proposed management activities. The potential for white pine blister rust can be assessed based on the presence of the primary host species (western white pine or sugar pine and gooseberry). The major limitations for these soils are fertility imbalances due to the ultramafic parent material, low AWC, areas of shallow soils, areas of high surface coarse fragments, areas of steep slopes, potentially high erodibility, susceptibility to burning damage, and susceptibility to compaction when soils are moist.

Closely Related Types

The Port Orford cedar-Western White Pine/Huckleberry Oak type is often located just upslope from the Port Orford cedar/Western Azalea type found in streamside positions. It is also the low elevation expression of the Port Orford cedar-White Fir-Western White Pine/Huckleberry Oak type. They differ in elevation and the lower degree of serpentinization found in the Port Orford cedar-White Fir-Western White Pine/Huckleberry Oak type and its significantly higher productivity.

Port Orford Cedar-White Fir/ Huckleberry Oak CHLA-ABCO/QUVA EcoCode CCOCFW11



huckleberry oak
(Quercus vaccinifolia)

Port Orford Cedar-White Fir/Huckleberry Oak CHLA-ABCO/QUVA Association, EcoCode CCOCFW11

SUMMARY TABLE

(Sample size: 10)		COVER	CON
Tree Overstory Layer			
CHLA	Port Orford Cedar	29	100
PSME	Douglas-fir	30	100
ABCO	White Fir	15	100
PILA	Sugar Pine	10	60
CADE3	Incense Cedar	8	60
Tree Understory Layer			
ABCO	White Fir	3	100
CHLA	Port Orford Cedar	2	100
PSME	Douglas-fir	2	70
PILA	Sugar Pine	1	60
CADE3	Incense Cedar	2	70
Shrubs			
QUVA	Huckleberry Oak	11	100
VAPA	Red Huckleberry	6	70
Herbs & Grasses			
XETE	Beargrass	3	70
CHUMO	Western prince's pine	2	70
TRLA3	Starflower	1	70

Environment

Elevation: 2980-4620 ft.

Aspect: N.E., W.

Slope: 18-68%

Slope Position: lower and middle 1/3

Surface Rock: 0-7%

Soils

Pit Depth: 9-40"+

Coarse Fragments: 25-52%

Textures: gl, vgl

Parent Material: serpentinite, peridotite, greenstone

Distribution/Environment

This type was widespread and found on the Gasquet, Orleans, Ukonom, and Happy Camp ranger districts in the lower and middle one-third slope positions with concave and linear micro-relief. Elevation averaged 3913 feet and ranged from 2980 to 4620 feet, on moderate (38%) slopes with northeast and west facing aspects. Radiation index was moderate (.451) as a result of west aspects. This type tended to occur on exposed sites where conditions are drier than most Port Orford cedar types. Surface rock was moderate, with an average of 5 percent cover.

Soil Summary

Soils in this type were primarily well drained and derived from the fine textured metamorphic parent materials peridotite, greenstone, and serpentinite. These soils had a slightly acidic surface pH (6.3) and a neutral subsurface pH (6.6). They were primarily moderately deep (40%), deep (40%), and occasionally shallow (20%), gravelly to very gravelly loams, with low to moderate AWC (2.6"), moderately thick A horizons (6"), and moderate A horizon coarse fragments (42%). They were found mainly in the frigid soil temperature regime and were moderately productive for conifer growth. The dominant soil families were loamy skeletal, mixed or serpentinititic, Dystric or Typic Xerochrepts.

Vegetation Summary

Total vegetation cover (93%) and overstory cover of 80 percent were high. Overstory conifer species included Douglas-fir (30%), which was codominant with Port Orford cedar (29%). White fir (15%), sugar pine (10%), and incense cedar (8%) were associate species. The tree regeneration layer was dominated by white fir (3%), Port Orford cedar (2%), Douglas-fir (2%), and sugar pine (1%). The shrub layer averaged 19% cover, which was among the lowest in the Port Orford cedar series. Huckleberry oak (11%) dominated here followed by red huckleberry (6%), dwarf Oregon-grape (2%), and Sadler oak (1%). Total forb cover (14%) was moderate; it included twinflower (7%), beargrass (3%), prince's pine (2%), western modesty (2%), starflower (1%), iris (1%), Hooker's fairybell (*Disporum hookeri*), and rattlesnake plantain (1%).

Disturbance and Age Class Distribution

Stands in this type had their age class distribution dominated by older age classes. They ranged in age from 265 to 443 years with an average of 344 years. The highest frequency of stands (40%) were found between 326 and 375 years of age. The frequency of stands above 300 years was 80 percent; the frequency of stands below 200 years was 0 percent. This dominance by older age stands indicates the low frequency of stand replacing fires that occur in this type.

Stand Structure Summary

Stands in this type had a mixture of tolerant and moderately intolerant conifers in the dense overstory, along with a variety of diameter classes, which resulted in multiple layers. The overstory was usually composed of at least two layers of different aged conifers, averaging 131 feet tall and 38 inches diameter in the top layer and 113 feet tall and 33 inches diameter in the second layer. It had a high density of large conifers, with an average of 25 trees/acre greater than 30 inches diameter. The mid layers were dominated by conifer species, they ranged from 25 to 70 feet tall. The regeneration layer was moderately dense.

Softwood cubic volumes ranged from low to moderate with an average of 11,867 ft3/acre. Dunning site class was 2, with site index of 150 at 300 years. Stand

density index was high with an average of 508.

Successional Trends

The Port Orford cedar-White Fir/Huckleberry Oak type has a moderate potential for alteration of its successional pathway with continued fir suppression. Fire suppression favors both the tolerant species white fir and Port Orford cedar on these cool, mesic sites, while the presence of huckleberry oak could lead to fires of stand replacing intensity during particularly dry periods. Fires of low intensity are the primary disturbance events in this type.

An additional threat to successional pathway alteration in this type is Port Orford cedar root disease. The risk of Port Orford cedar root disease is low in this type due to its upslope position away from stream courses.

Rare Plant Relationships

No rare or sensitive plants have been identified in this type to date.

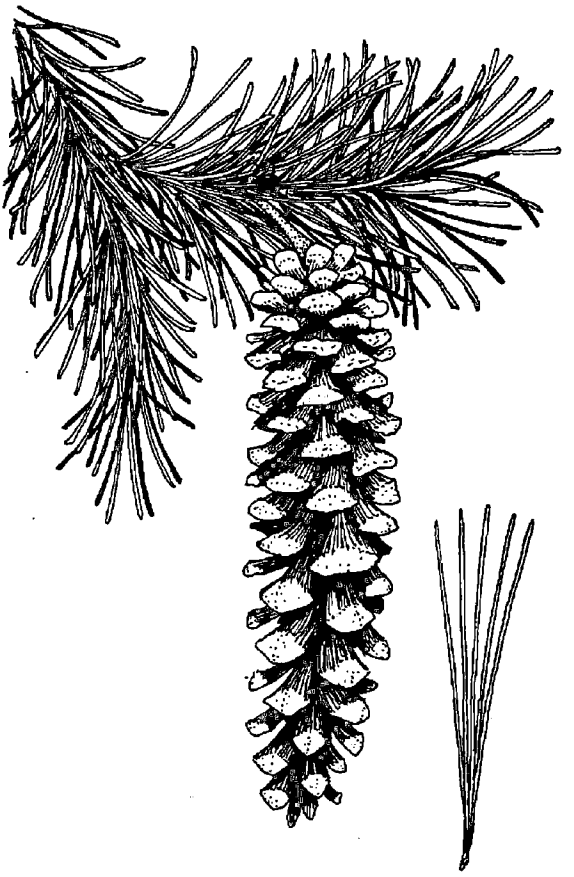
Management Implications

The major limitations for management in this type are related to disease and soils. The threat of introduction of Port Orford cedar root disease needs to be considered in any proposed management activities. The major limitations for these soils are fertility imbalances and susceptibility to burning damage in areas of ultramafic parent material, along with cold soil temperatures in the frigid soil temperature regime which could inhibit regeneration.

Closely Related Types

The Port Orford cedar-White Fir/Huckleberry Oak type is closely related to the Port Orford cedar-White Fir-Western White Pine/Huckleberry Oak type found on higher elevation, colder sites. They differ in elevation the presence of western white pine and the higher density of shrubs in the latter type.

Port Orford Cedar-White Fir-Western White Pine/Huckleberry Oak
CHLA-ABCO-PIMO3/QUVA
EcoCode CCOCFW12



western white pine
(Pinus monticola)

Port Orford Cedar-White Fir-Western White Pine/ Huckleberry Oak
CHLA-ABCO-PIMO3/QUVA Assoc., EcoCode CCOCFW12

SUMMARY TABLE

(Sample size: 10)		COVER	CON
Tree Overstory Layer			
CHLA	Port Orford Cedar	21	100
PSME	Douglas-fir	17	100
ABCO	White Fir	11	100
PIMO3	Western White Pine	11	100
Tree Understory Layer			
CHLA	Port Orford Cedar	2	100
ABCO	White Fir	2	90
PIMO3	Western White Pine	1	70
Shrubs			
QUVA	Huckleberry Oak	29	100
ARNE2	Pinemat Manzanita	8	80
QUSA	Sadler Oak	4	60
ROGY	Wild Rose	2	60
Herbs & Grasses			
CHUMO	Western prince's pine	2	90
XETE	Beargrass	4	90
DIHO2	Hooker's Fairybell	1	50
IRI	Iris	1	60

Environment

Elevation: 4360-5180 ft.

Aspect: N.W.

Slope: 10-45%

Slope Position: middle and upper 1/3

Surface Rock: 2-10%

Soils

Pit Depth: 14-40"+

Coarse Fragments: 30-85%

Textures: gl, vgcl, xgl

Parent Material: serpentinite, peridotite

Distribution/Environment

This type was found on the Gasquet, Ukonom, and Happy Camp ranger districts in the middle and lower one-third slope positions with undulating, linear micro-relief. Elevation averaged 4756 feet, highest of all Port Orford cedar types. It ranged from 4360 to 5180 feet on gentle (27%) slopes with northwest facing aspects. Radiation index was low (.412) as a result of northwest aspects. This type tended to be found on cold sites that were exposed to heavy winter snow packs. Surface rock was moderate with an average of 7 percent cover.

Soil Summary

Soils in this type were well drained and derived from the fine textured peridotite and serpentinite parent rocks and had a slightly acidic surface pH (6.2) and a neutral subsurface pH of 6.7. They were primarily moderately deep (50%), deep (25%), and shallow (25%), very gravelly to extremely gravelly loams, with low AWC (2.5"), moderately thick A horizons (6"), and moderate to very high A horizon coarse fragments (43%). They were found entirely in the frigid soil temperature regime and were moderately productive for conifer growth. The dominant soil families were loamy skeletal, mixed, Dystric Xerochrepts (37%) and loamy skeletal, serpentinitic, Typic Xerochrepts (63%).

Vegetation

Total vegetation cover was moderate (92%) ,and overstory cover of 68 percent was among the lowest in the Port Orford cedar series. Overstory dominance was held by Port Orford cedar (31%); associate species included Douglas-fir (17%), white fir (11%), western white pine (11%), and incense cedar (4%). The tree regeneration layer was dominated by Port Orford cedar (2%), white fir (2%), and western white pine (1%). The shrub layer averaged 52% cover, which was moderate for the Port Orford cedar series. Huckleberry oak (29%) dominated here, followed by pinemat manzanita (8%), Sadler oak (4%), wild rose (2%), and Pacific blackberry (2%). Total forb cover (8%) was moderate; it included beargrass (4%), prince's pine (2%), Hooker's fairybell (1%), queen's cup (*Clintonia uniflora*) (1%), and iris (1%).

Disturbance and Age Class Distribution

Stands in this type had their age class distribution dominated by stands greater than 300 years old. They ranged in age from 310 to 450 years with an average of 356 years, among the oldest in the Port Orford cedar series. This dominance by older age stands indicates the low frequency of stand replacing fires that occur in this type.

Stand Structure Summary

Stands in this type had a mixture of tolerant, moderately intolerant, and intolerant conifers in the relatively open overstory, along with a variety of diameter classes which resulted in multiple layers. The overstory was usually composed of at least two layers of different aged conifers, averaging 112 feet tall and 38 inches in diameter in the top layer and 79 feet tall and 26 inches in diameter in the second layer. It had a high density of large conifers, with an average of 34 trees/acre greater than 30 inches diameter. The mid layers were dominated by conifer species; they ranged from 20 to 50 feet tall.

The regeneration layer was dense due to the open canopy. Softwood cubic volumes ranged from moderate to high with an average of 11,043 ft3/acre. Dunning site class was 2, with site index of 150 at 300 years. Stand density index was high; highest of all Port Orford cedar types on serpentine soils, it averaged 540.

Successional Trends

The Port Orford cedar-White Fir-Western White Pine/Huckleberry Oak type has a low potential for alteration of its successional pathway with continued fir suppression. This is due to the mesic nature of this type related to its position just upslope from perennial streams. Moisture conditions and cold air flow favor Port Orford cedar, white fir, and western white pine regeneration. Fires of low intensity are the primary disturbance events, with occasional high intensity events during dry periods related to the high shrub cover.

The main threats to successional pathway alteration in this type are Port Orford cedar root disease and white pine blister rust. The risk of Port Orford cedar root disease is low in this type due to its upslope position and low density of Port Orford cedar trees. White pine blister rust could significantly alter species composition and favor other species such as Douglas-fir.

Rare Plant Relationships

No rare or sensitive plants have been identified in this type.

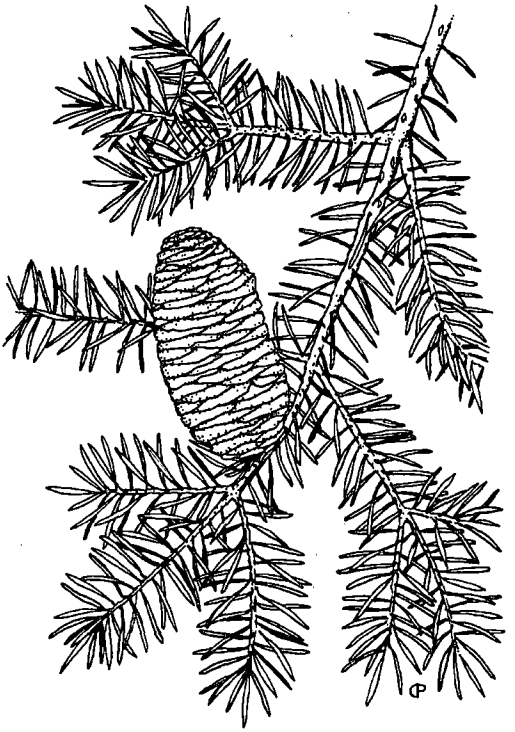
Management Implications

The major limitations for management in this type are related to disease and soils. The threat of introduction of Port Orford cedar root disease needs to be considered in any proposed management activities. The potential for white pine blister rust can be assessed based on the presence of the primary host species (western white pine or sugar pine and gooseberry). Management problems related to soils include fertility imbalances due to ultramafic parent material, susceptibility to burning damage, high coarse fragments, low AWC, and cold soil temperatures in the frigid soil temperature regime which may inhibit regeneration.

Closely Related Types

The Port Orford cedar-White Fir-Western White Pine/Huckleberry Oak type is often located just upslope from the Port Orford cedar/Western Azalea type found in streamside positions. It is also the high elevation expression of the Port Orford cedar-Western White Pine/Huckleberry Oak type. They differ in the lower degree of serpentinization found in the Port Orford cedar-White Fir-Western White Pine/ Huckleberry Oak type and its significantly higher productivity.

Port Orford Cedar-White Fir/
Western Azalea
CHLA-ABCO/RHOC
EcoCode CCOCFW13



white fir
(Abies concolor)

Port Orford Cedar-White Fir/**Western Azalea**
CHLA-ABCO/RHOC Association, EcoCode CCOCFW13

SUMMARY TABLE

(Sample size: 10)		COVER	CON
Tree Overstory Layer			
CHLA	Port Orford Cedar	49	100
PSME	Douglas-fir	13	100
ABCO	White Fir	10	100
PILA	Sugar Pine	9	70
Tree Understory Layer			
ABCO	White Fir	2	100
CHLA	Port Orford Cedar	1	100
Shrubs			
RHOC	Western Azalea	32	100
QUVA	Huckleberry Oak	4	80
RUUR	Pacific blackberry	2	70
Herbs & Grasses			
CHUMO	Western prince's pine	1	70
TRLA3	Starflower	1	70
GOOB	Rattlesnake Plantain	1	60
CAR	Sedge	1	50

Environment

Elevation: 3740-4320 ft.

Aspect: N.E., S.

Slope: 10-53%

Slope Position: lower & middle1/3

Surface Rock: 2-9%

Soils

Pit Depth: 25-40"+

Coarse Fragments: 10-46%

Textures: gl, vgl

Parent Material: serpentinite & peridotite.

Distribution/Environment

This type was most common on inland sites found on the Orleans, Ukonom, and Happy Camp ranger districts in the middle and lower one-third slope positions with undulating, concave, and linear micro-relief. Elevation averaged 4040 feet and ranged from 3740 to 4320 feet, on gentle (31%) slopes with northeast and south facing aspects. Radiation index was high (.461) as a result of south aspects. Surface rock was low here with an average of 4 percent surface cover.

Soil Summary

Soils in this type were well drained, derived from the fine textured ultramafic parent materials peridotite and serpentinite. These soils had a slightly acidic surface pH (6.5) and a neutral subsurface pH (7.0). They were deep (66%) and moderately deep (33%), gravelly to very gravelly loams, with high AWC (4.2"), moderately thick A horizons (6"), and low A horizon coarse fragments (28%). They were found in the frigid soil temperature regime and were moderately productive for conifer growth. The dominant soils were fine loamy or loamy skeletal, serpentinitic or mixed, Typic Xerochrepts (50%) and loamy skeletal, serpentinitic, Typic Hapludults (25%).

Vegetation Summary

Total vegetation cover was dense (92%), and overstory cover of 75 percent was moderate. The overstory was dominated by Port Orford cedar (49%), with Douglas-fir (13%), white fir (10%), and sugar pine (9%) as associate species. The tree regeneration layer was dominated by white fir (2%) and Port Orford cedar (1%). The shrub layer averaged 41 percent cover, which was moderate for the Port Orford cedar series. Western azalea (32%) dominated here with huckleberry oak (4%), Pacific blackberry (2%), and red huckleberry (2%) as associates. Total forb cover (6%) was moderate; it included prince's pine (1%), starflower (1%), rattlesnake plantain (1%), white-veined wintergreen (1%), queens cup (1%), and bracken fern (1%). Sedge species (1%) dominated the grass layer.

Disturbance and Age Class Distribution

Stands in this type had a relatively even age class distribution dominated by stands greater than 300 years old. They ranged in age from 222 to 550 years with an average of 354 years. The highest frequency of stands (22%) were found between 226 and 275 years of age. The frequency of stands above 300 years was 56 percent; the frequency of stands below 200 years was 0 percent. This dominance by older age stands indicates the low frequency of stand replacing fires that occur in this streamside type.

Stand Structure Summary

Stands in this type had a mixture of tolerant and moderately intolerant conifers in the moderately dense overstory, along with a variety of diameter classes which resulted in multiple layers. The overstory was usually composed of at least two layers of different aged conifers, averaging 133 feet tall and 38 inches in diameter in the top layer and 101 feet tall and 25 inches in diameter in the second layer. It had a high density of large conifers, with an average of 24 trees/acre greater than 30 inches diameter. The mid layers were dominated by conifer species; they ranged from 25 to 70 feet tall. The regeneration layer was low due to a dense shrub layer and high number of intermediate conifers.

Softwood cubic volumes ranged from low to moderate with an average of 11,173 ft3/acre. Dunning site class was 3, with site index of 125 at 300 years. Stand density index was moderate with an average of 496.

Successional Trends

The Port Orford cedar-White Fir/Western Azalea type has a low potential for

alteration of its successional pathway with continued fir suppression. This is due to its moist, streamside position adjacent to perennial streams. Moisture conditions and cold air flow in these drainages favor both Port Orford cedar and white fir regeneration. Flooding is likely the primary disturbance event here, with rare high intensity fire events during dry periods related to the high shrub cover.

The main threat to successional pathway alteration in this type is Port Orford cedar root disease. The risk of Port Orford cedar root disease is high in this type due to its streamside position.

Rare Plant Relationships

No rare or sensitive plants have been identified in this type to date.

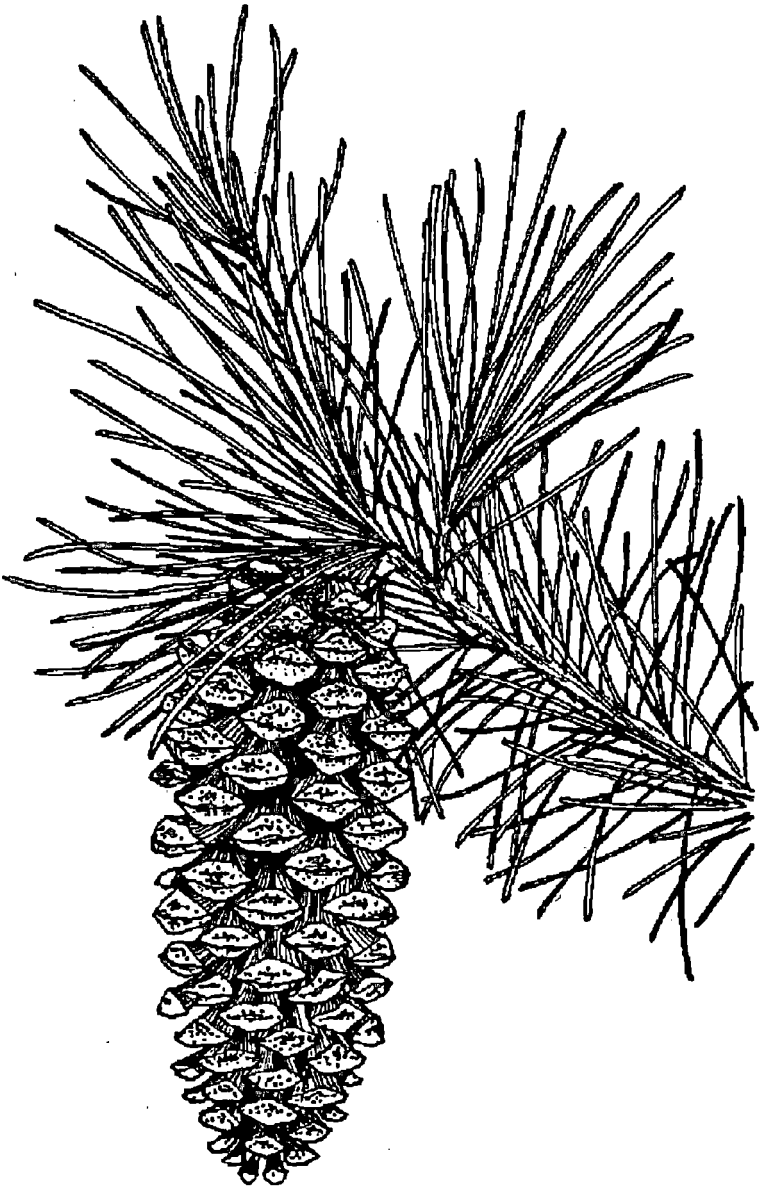
Management Implications

The major limitations for management in this type are related to disease and its streamside position. The threat of introduction of Port Orford cedar root disease needs to be considered in any proposed management activity planned in or near this type. The major limitations for soils in this type are fertility imbalances in areas of ultramafic parent material, susceptibility to burning damage, and areas of seeps or poorly drained soils.

Closely Related Types

The Port Orford cedar-White Fir/Western Azalea type is closely related to the Port Orford cedar/Western Azalea type found in lower elevation streamside positions. They differ in elevation and the lower degree of serpentinization found in the Port Orford cedar-White Fir/Western Azalea type.

Sugar Pine Series



INTRODUCTION TO THE SUGAR PINE SERIES

The sugar pine series was described using 30 ecology plots distributed within Del Norte and Humboldt Counties. The highest frequency of plots were sampled in Del Norte County, where the greatest extent of serpentine soils were found (fig.1).

Analysis of the sample data identified three subseries, containing four plant associations in the sugar pine series (Table 8). The highest number of plant associations were identified on the Gasquet Ranger Districts (4).

The plant associations of the sugar pine series were arrayed along elevation/ moisture/parent material gradients (figure 15) and differed from one another by elevation, distance from the ocean, soil depth, surface and subsurface pH, aspect, surface gravel and rock, and radiation index. Elevation ranged from 2777 to 4800 feet and influenced soil temperature and the length of the growing season. Sites were mostly rocky, in ridgetop and upper one-third slope positions that ranged from 5 to 50% steepness. Sugar pine plant associations were found on mainly northeast, east and south aspects, which may be moderated in coastal associations by the cooling effects of the Pacific Ocean. Distance from the ocean varied by plant association from 14.9 miles to 21.2 miles. It was a key variable in discriminating between plant associations due to its influence on moisture conditions. Stands found near the ocean were often subjected to maritime influences such a coastal fog and high winter snow packs both provide a cooling influence as well as additional moisture to the site. Inland stands appeared much drier and warmer, with significantly higher surface rock. This environment change was reflected in their species composition, for example the absence of dwarf tanbark on inland sites. Parent material was primarily serpentinite with the exception of the Sugar Pine-Chinquapin/ Huckleberry Oak-Sadler Oak type which was found on soils derived from sandstone parent material. Surface and subsurface pH ranged from 6.2 to 7.0 and were indicators of parent material origin and soil development. Soil development was also affected by distance from the ocean and slope position. Soils in ridgetop or spur ridge positions were of lower development than those in lower slope positions due to continuous soil loss in ridgetop sites versus accumulation in lower slope positions. This was verified by the higher frequency of Entisols in the ridgetop and upper one-third slope positions.

Plant associations in the sugar pine series were arranged along the environment gradients described above as follows. The Sugar Pine-Lodgepole Pine/ Huckleberry Oak-Pacific Rhododendron type was found on the lowest elevation, cool sites, with moderate slopes, in close proximity to the ocean (figure 15). It was followed on mid elevation, cool sites by the Sugar Pine-Lodgepole Pine/ Huckleberry Oak-Dwarf Tanbark type and on slightly higher, cool sites on sandstone parent material by the Sugar Pine-Chinquapin/ Huckleberry Oak-Sadler Oak type. Farther inland on high elevation, cool, dry sites, the Sugar Pine-Western White Pine/Huckleberry Oak-Dwarf Silktassel type was found. They were discriminated from one another by elevation, distance from the ocean, surface litter, surface and subsurface pH, soil depth, aspect, radiation index, surface gravel and rock.

Productivity was very low to low in all sugar pine plant associations as a result of parent material, soils, and slope position. Stand structure also varied by

Table 8. Plant associations found in the Sugar Pine series.

EDP CODE	PLANT ASSOCIATION NAME
PILA-CACH2 Subseries	Sugar Pine-Chinquapin
PILA-CACH2/QUVA-QUSA	Sugar Pine-Chinquapin/Huckleberry Oak-Sadler Oak
PILA-PICO1 Subseries	Sugar Pine-Lodgepole Pine
PILA-PICO1/QUVA-LIDEE	Sugar Pine-Lodgepole Pine/Huckleberry Oak-Dwarf Tanbark
PILA-PICO1/QUVA-RHMA	Sugar Pine-Lodgepole Pine/Huckleberry Oak-Pacific Rhododendron
PILA-PIMO3 Subseries	Sugar Pine/Western White Pine
PILA-PIMO3/QUVA-GABU2	Sugar Pine-Western White Pine/ Huckleberry Oak-Dwarf Silktassel

plant association as a result of soils and topographic position. The Sugar Pine-Chinquapin/Huckleberry Oak-Sadler Oak type had the tallest mean tree height in the top and second layers with means of 99 and 91 feet. It also had the largest mean diameter in the top layer 35 inches dbh and largest diameter in the second layer 27 inches dbh. In contrast, the Sugar Pine-Lodgepole Pine/ Dwarf Tanbark-Pacific Rhododendron type had the shortest mean tree height of 45 feet in the top layer and smallest mean diameter of 10 inches dbh.

Vegetation composition reflects the environments described above. For instance, the Sugar Pine-Chinquapin/Huckleberry Oak-Sadler Oak type is found on mesic, mid elevation cool sites. Sadler Oak is the indicator species. It distinguishes this plant association from all others in the series. Mesic indicator species in the sugar pine series include chinquapin, salal, and dwarf tanbark. Wet indicator species include Pacific rhododendron, western azalea, and sedges. Dry indicator species include huckleberry oak, dwarf silktassel, coffeeberry, and common juniper. Cool, high elevation site indicators include western white pine and lodgepole pine.

Age class distribution is used here as an indicator of disturbance in the form of stand replacing fires. The highest frequency of stand replacing fires, based on youngest mean stand age and highest frequency of stands below 200 years stand age, was the Sugar Pine-Lodgepole Pine/Dwarf Tanbark-Pacific Rhododendron type. Lodgepole pine is included in the name of this plant association and the Sugar Pine-Lodgepole Pine/Huckleberry Oak-Dwarf Tanbark type due to it's early seral dominance. The Sugar Pine-Lodgepole Pine/Dwarf Tanbark-Pacific Rhododendron has a dense shrub layer that provides ladder fuels that tend to contribute to stand replacing fires. It was followed in stand replacing fire frequency by the Sugar Pine-Lodgepole Pine/ Huckleberry Oak-Dwarf Tanbark type. The lowest frequency of stand replacing fires occurred in the Sugar Pine-Chinquapin/Huckleberry Oak-Sadler Oak and Sugar Pine Western White Pine/Huckleberry Oak-Dwarf Silktassel types. These high elevation types had more mesic conditions in the former and a high percentage of rock covered ground in the latter. Both of these conditions discourages fire spread and add to the low frequency of stand replacing fires.

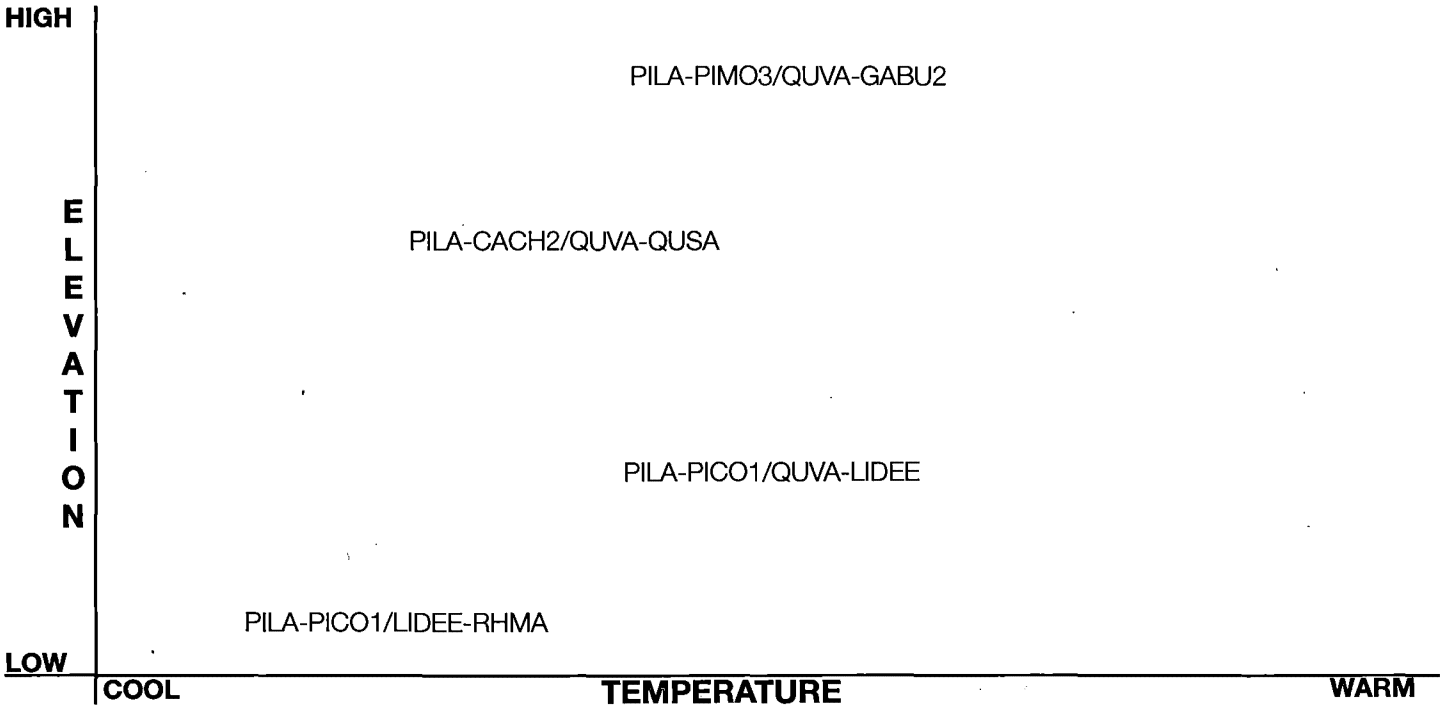


FIGURE 15. Relative relationships of plant association in the Sugar Pine Series based on elevation and temperature.

The Sugar Pine series had a low frequency of rare plants. To date only the Del Norte County iris, Bolander's lily, and Washington lily have been identified within its plant associations.

SUGAR PINE SERIES KEY

1 a. Bush chinquapin and Sadler oak present PILA-CACH2/QUVA-QUSA

1 b. Not as above 2

2 a. Pacific rhododendron cover ≥ 5% PILA-PICO1/LIDEE-RHMA

2 b. Pacific rhododendron absent or not as above 3

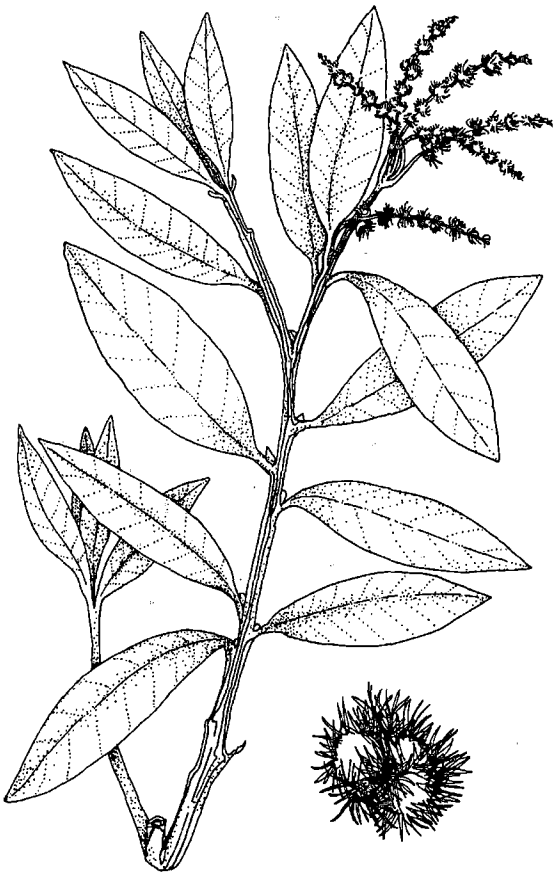
3 a. Huckleberry oak cover ≥ 10% 4

4 a. Dwarf tanbark cover ≥ 5%, sites generally coastal PILA-PICO1/QUVA-LIDEE

4 b. Dwarf tanbark absent, sites generally inland PILA-PIMO3/QUVA-GABU2

3 b. Huckleberry oak absent or not as above ..... Return to step 1 and try again.

Sugar Pine-Chinquapin/
Huckleberry Oak-Sadler Oak
PILA-CACH2/QUVA-QUSA
EcoCode CPWCD011



chinquapin
(Castanopsis chrysophylla)

Sugar Pine-Chinquapin/Huckleberry Oak-Sadler Oak PILA-CACH2/QUVA-QUSA, EcoCode CPWCD011

SUMMARY TABLE

(Sample size: 10)		COVER	CON
Tree Overstory Layer			
PILA	Sugar Pine	18	100
PSME	Douglas-fir	4	60
CACH2	Chinquapin	3	50
Tree Understory Layer			
PILA	Sugar Pine	2	100
PSME	Douglas-fir	1	80
CACH2	Chinquapin	7	60
Shrubs			
QUSA	Sadler Oak	8	100
QUVA	Huckleberry Oak	18	100
ARNE2	Pinemat Manzanita	18	100
LIDEE	Dwarf Tanbark	15	70
VAPA	Red Huckleberry	7	70
Herbs & Grasses			
XETE	Beargrass	13	100
PTAQL	Bracken Fern	1	50
PYPI	White-veined Wintergreen	1	60

Environment

Elevation: 3350-4620 ft.

Aspect: E.,S.

Slope: 20-45%

Slope Position: upper 1/3

Surface Rock: 2-25%

Soils

Pit Depth: 32-40"+

Coarse Fragments: 17-30%

Textures: sl,gl

Parent Material: sandstone & mafic

Distribution/Environment

The Sugar Pine-Chinquapin/Huckleberry Oak-Sadler Oak type was found on the Gasquet and Orleans Ranger Districts. Mean distance to the Pacific Ocean was 14.9 miles in these upper one-third slope positions. Elevation averaged 3952 feet and ranged from 3350 to 4620 feet, highest of all Sugar pine plant associations. Slopes were moderately steep (33%), east and south facing with high radiation index (.520) as a result aspect.

Soil Summary

Soils in this type were derived from coarse textured sandstone and mafic parent rocks. These rocks impart a slightly acid surface pH of 6.4 and subsurface pH of 6.2, lowest in the sugar pine series. Soils were well drained, moderately deep (50%) and deep (50%), sandy loams and gravelly loams, with low AWC (1.7"), thin A horizons (3"), and low A horizon coarse fragments (24%). They were found in the frigid soil temperature regime and were of low productivity for conifer growth. The dominant soil families were loamy-skeletal, mixed, frigid, Typic Xerochrepts (50%) and loamy-skeletal, mixed, frigid, Typic Haploxerults (34%).

Vegetation

Total vegetation cover was high and ranged from 85-99% with an average of 95%. Overstory cover of 26% was the lowest of all sugar pine plant associations. The dominant overstory species was sugar pine (18%), with Douglas-fir (4%) and chinquapin (3%) as occasional associates. The regeneration layer included sugar pine (2%), Douglas-fir (1%), and chinquapin (7%). The shrub layer was dense with average cover of 76%. It included huckleberry oak (18%), pinemat manzanita (18%), dwarf tanbark (15%), Sadler oak (8%), and red huckleberry (7%). The forb layer was of moderate cover 14% and dominated by beargrass (13%), with occasional occurrences of bracken fern (1%) and white-veined wintergreen (1%). The grass layer was lacking in this type.

Disturbance and Age Class Distribution

Stands found in this type ranged in age from 150 to 410 years with an average age of 273 years, oldest in the sugar pine series. The highest frequency of stands (50%) were found between 176 and 275 years of age. The frequency of stands above 300 years was 40% and the frequency of stands below 200 years was 20%. The relatively even distribution of stands by age class category indicates that stand replacing fires have occurred with regularity, particularly in the period between 1595 and 1845. Fire intensity between 1845 and 1995 appears to have been restricted to low intensity, non-stand replacing events.

Stand Structure Summary

This type had a moderately open mixture of uneven-aged, moderately tolerant tree species, from a variety of diameter and age classes, which often resulted in multiple layers. The overstory was usually composed of at least three layers of different aged conifers. The top layer was dominated by sugar pine, while the second and third layers included Douglas-fir and chinquapin as associates with sugar pine. The top layer had an average height of 99 feet and diameter of 35 inches. The second layer had an average height of 90 feet and diameter of 27 inches. The height and diameter of the third layer averaged 44 feet and 18 inches respectively.

Softwood cubic volume ranged from very low to moderately low values with an average of 2,414 $ft.^3$ which is above the average for all types in the sugar pine series (1,523 $ft.^3$). Basal area also ranged from very low to moderate with an average of 114 $ft.^2$, this was at the average for the series of 111 $ft.^2$. Dunning site class was 4 with site index of 100 at 300 years. Stand density index was moderately low with an average of 230.

Successional Trends

The Sugar Pine-Chinquapin/Huckleberry Oak-Sadler Oak type has a moderate potential for alteration of its successional pathway with continued fire suppression. This is due to the high cover of shrubs which during dry periods would contribute to fires of stand replacing intensity. Repeated high intensity fires could lead to the elimination of the sugar pine seed source and hence alter the successional pathway. This scenario would favor fire related species such as lodgepole pine and knobcone pine. Low and moderate intensity fires would have a low probability of altering the successional pathway, due to the thick bark of sugar pine which is fire resistant. A more likely alteration of the successional pathway could result from mortality in the regeneration layer. Here, white pine blister rust kills young sugar pine with higher frequency than older trees. This would also favor other species such as lodgepole pine and knobcone pine.

Rare Plant Relationships

The rare plant species Del Norte County iris and Bolander's lily were identified in this type.

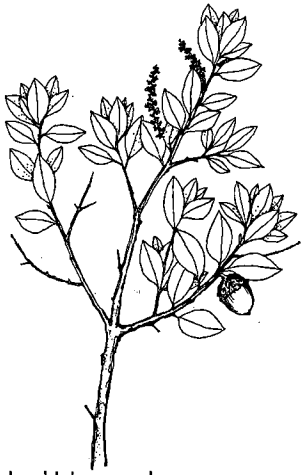
Management Implications

The Sugar Pine-Chinquapin/Huckleberry Oak-Sadler Oak type had a sparse overstory of low productivity, with high mortality from white pine blister rust. It is not suitable for intensive forest management, but could produce low salvage outputs from white pine blister rust mortality. The dense shrub layer produces a variety of fruits and acorns that are favored by songbirds, deer, and bear.

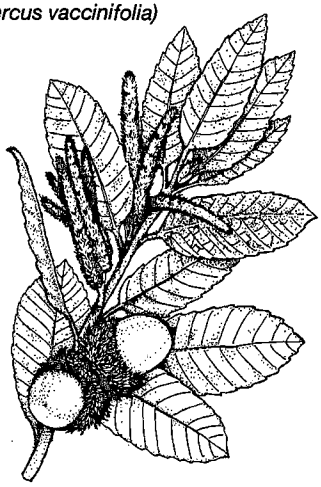
Closely Related Types

The Sugar Pine-Chinquapin/Huckleberry Oak-Sadler Oak type is often found upslope from the Douglas-fir/Huckleberry Oak type on poor sites and upslope from the Douglas-fir-Chinquapin subseries on better sites.

Sugar Pine-Lodgepole Pine/ Huckleberry Oak-Dwarf Tanbark PILA-PICO1/QUVA-LIDEE EcoCode CPSCPL11

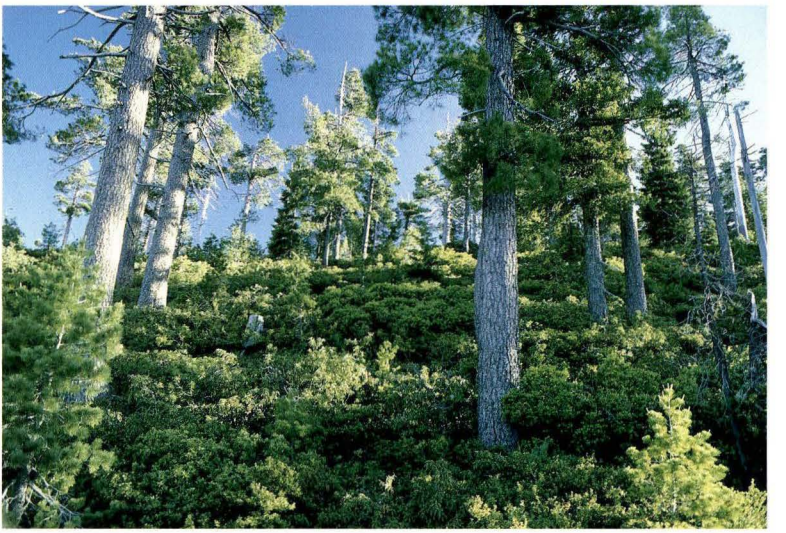


huckleberry oak
(Quercus vaccinifolia)



dwarf tanbark
(Lithocarpus densiflorus ssp. echinoides)

Sugar Pine-Lodgepole Pine/Huckleberry Oak-Dwarf Tanbark
PILA-PICO1/QUVA-LIDEE, EcoCode CPSCPL11



SUMMARY TABLE

(Sample size: 10)		COVER	CON
Tree Overstory Layer			
PILA	Sugar Pine	18	100
PIMO3	Western White Pine	8	50
PICO1	Lodgepole Pine	23	40
PIAT1	Knobcone Pine	5	30
Tree Understory Layer			
PILA	Sugar Pine	3	100
PIMO3	Western White Pine	1	50
CADE3	Incense Cedar	3	30
Shrubs			
LIDEE	Dwarf Tanbark	16	100
QUVA	Huckleberry Oak	22	100
VAPA	Red Huckleberry	8	100
ARNE2	Pinemat Manzanita	22	80
Herbs & Grasses			
XETE	Beargrass	11	100
PYPI	White-veined Wintergreen	1	60
WHMO	Western modesty	1	50

Environment

Elevation: 2000-3980ft.

Aspect: S., W.

Slope: 10-45%

Slope Position: ridgetop, upper,and middle 1/3

Surface Rock: 21-50%

Soils

Pit Depth: 10-40"+

Coarse Fragments: 20-60%

Textures: scl,gl,sil

Parent Material: serpentine

Distribution/Environment

The Sugar Pine-Lodgepole Pine/Huckleberry Oak-Dwarf Tanbark type was found on the Gasquet Ranger District. Mean distance to the Pacific Ocean was 16.3 miles in these ridgetop, upper and middle one-third slope positions. Elevation averaged 3340 feet and ranged from 2000 to 3980 feet, second lowest of all Sugar pine plant associations. Slopes were moderately steep (23%), south and west facing with high radiation index (.510) as a result aspect.

Soil Summary

Soils in this type were derived from fine textured serpentiniteparent rocks. These rocks imparted a neutral surface pH of 6.7 and subsurface pH of 6.9. Soils were well drained, moderately deep (56%), shallow (33%), and deep (11%), silt loams, sandy clay loams and gravelly loams, with low AWC (2.1"), moderate A horizons (5"), and moderate A horizon coarse fragments (32%). They were found in the mesic and frigid soil temperature regime and were of low productivity for conifer growth. The dominant soil families were fine-loamy, serpentinitic, frigid, Typic Xerochrepts (60%) and loamy-skeletal, serpentinitic, mesic, Typic Haploxeralfs (30%).

Vegetation

Total vegetation cover was high and ranged from 80-99% with an average of 91%. Overstory cover of 33% was low with sugar pine (18%) as the dominant overstory species. Western white pine (8%), lodgepole pine (23%), and knobcone pine (5%) were occasional associates. The regeneration layer was dominated by sugar pine (3%), with western white pine (1%), and incense cedar (3%) as infrequent associates. The shrub layer was dense with an average cover of 76% and a variety of species. It included huckleberry oak (22%), red huckleberry (8%), pinemat manzanita (22%), dwarf tanbark (16%), coffeeberry (3%), Pacific serviceberry (2%), Dwarf Silktassel (4%), common juniper (4%), creeping Oregon-grape (1%), greenleaf manzanita (7%), whiteleaf manzanita (41%), California bay (6%), and squawcarpet (4%). The forb layer was of moderate cover 11% and dominated by beargrass (11%), with occasional occurrences of western modesty (1%), iris (2%), prince's pine (1%), and white-veined wintergreen (1%). The grass layer was of low cover, 2% and included California fescue (1%) and sedge (4%).

Disturbance and Age Class Distribution

Stands found in this type ranged in age from 84 to 325 years with an average age of 169 years. The highest frequency of stands (66%) were found below 175 years of age. The frequency of stands above 300 years was 11% and the frequency of stands below 200 years was 67%. This shift in stand age towards dominance by younger stands indicates that stand replacing fires have occurred with regularity, particularly in the period between 1820 and 1910. Fire intensity between 1910 and 1995 appear to have been restricted to low intensity, non-stand replacing events.

Stand Structure Summary

This type had a moderately open mixture of uneven-aged, moderately tolerant tree species, from a variety of diameter and age classes, which often resulted in multiple layers. The overstory was usually composed of at least two layers of different aged conifers. The top layer was dominated by sugar pine, while the second layer included western white pine, lodgepole pine, and knobcone pine as associates with sugar pine. The top layer had an average height of 77

feet and diameter of 26 inches. The second layer had an average height of 52 feet and diameter of 14 inches.

Softwood cubic volume ranged from very low to low values with an average of 1,421 $ft.^3$ which is just below the average for all types in the sugar pine series (1,523 $ft.^3$). Basal area also ranged from very low to moderate with an average of 95 $ft.^2$, this was also below the average for the series of 111 $ft.^2$. Dunning site class was 5 with site index of 75 at 300 years. Stand density index was the lowest in the sugar pine series with an average of 161.

Successional Trends

The Sugar Pine-Lodgepole Pine/Huckleberry Oak-Dwarf Tanbark type has a moderate potential for alteration of its successional pathway with continued fire suppression. This is due to the high cover of shrubs which during dry periods would contribute to fires of stand replacing intensity. Repeated high intensity fires could lead to the elimination of the sugar pine seed source and hence alter the successional pathway. This scenario would favor fire related species such as lodgepole pine and knobcone pine present in this type. Low and moderate intensity fires probably account for the presence of these fire related species in these stands. Loss of sugar pine due to these fires is low due to the thick bark of sugar pine which is fire resistant. A more likely alteration of the successional pathway could result from mortality in the regeneration layer. Here, white pine blister rust kills young sugar pine with higher frequency than older trees. This would also favor other species such as lodgepole pine and knobcone pine.

Rare Plant Relationships

The rare plant Bolander's lily was identified in this type. It appeared to do best in areas where shrub cover was high. This may be due to the micro-climate under the shrubs and/or the avoidance of herbivory from the high numbers of deer and bear utilizing this type.

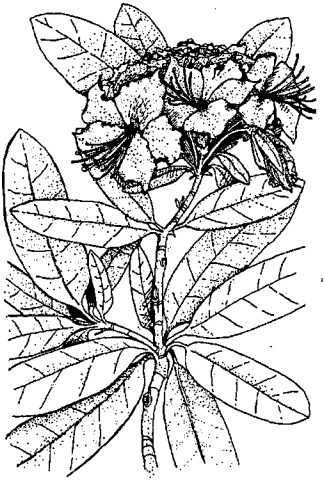
Management Implications

The Sugar Pine-Lodgepole pine/Huckleberry Oak-Dwarf Tanbark type had a sparse overstory of low productivity, with high mortality from white pine blister rust. It is not suitable for intensive forest management, but could produce low levels of salvage. The dense shrub layer produces a variety of fruits and acorns that are favored by songbirds, deer, and bear.

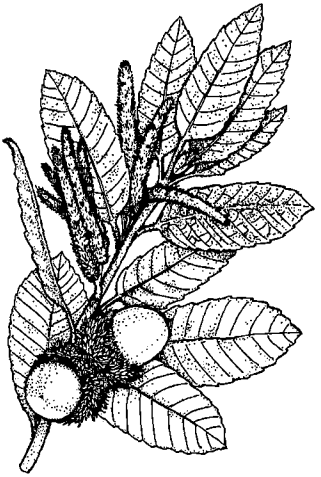
Closely Related Types

The Sugar Pine-Lodgepole Pine/Huckleberry Oak-Dwarf Tanbark type is often found in close proximity to the Western White Pine-Sugar Pine/Huckleberry Oak-Dwarf Tanbark type. The former type is found on sites with shallower soils and good air drainage. The latter type has deeper soils, but is prone to high snow packs due to its proximity to the ocean and cold air accumulation due to slope position and slope shape. The Port-Orford cedar/Western Azalea type is also found in close proximity to the Sugar Pine-Lodgepole Pine/Huckleberry Oak-Dwarf Tanbark type in streamside positions. The closely related Sugar Pine-Western White Pine/Huckleberry Oak-Dwarf Silktassel type is found inland from the Sugar Pine-Lodgepole Pine/Huckleberry Oak-Dwarf Tanbark type on drier, higher elevation sites. One significant difference between these types is the loss of dwarf tanbark on the inland sites. This appears to be due to dwarf tanbark's mesic nature and higher moisture requirements absent from the inland sites.

Sugar Pine-Lodgepole Pine/Dwarf Tanbark-Pacific Rhododendron PILA-PICO1/LIDEE-RHMA EcoCode CPSCPL12



Pacific rhododendron
(Rhododendron macrophyllum)



dwarf tanbark
(Lithocarpus densiflorus ssp. echinoides)

Sugar Pine-Lodgepole Pine/Dwarf Tanbark-Pacific Rhododendron
PILA-PICO1/LIDEE-RHMA, EcoCode CPSCPL12

SUMMARY TABLE

(Sample size: 6)		COVER	CON
Tree Overstory Layer			
PILA	Sugar Pine	8	100
PSME	Douglas-fir	5	83
PICO1	Lodgepole Pine	43	66
PIMO3	Western White Pine	5	33
Tree Understory Layer			
PSME	Douglas-fir	1	100
PILA	Sugar Pine	1	83
PIMO3	Western White Pine	1	33
Shrubs			
QUVA	Huckleberry Oak	20	100
RHMA	Pacific Rhododendron	14	100
LIDEE	Dwarf Tanbark	30	100
AMAL	Pacific Serviceberry	4	83
VAPA	Red Huckleberry	8	66
Herbs & Grasses			
XETE	Beargrass	9	100
PYPI	White-veined Wintergreen	1	33
LIBO	Bolander's Lily	1	33
LUCO	Heath Woodrush	1	33

Environment

Elevation: 2100-3280 ft.
Aspect: N.E.
Slope: 5-40%
Slope Position: lower 1/3
Surface Rock: 10-20%

Soils

Pit Depth: 15-32"+
Coarse Fragments: 10-40%
Textures: l,gl,gsil
Parent Material: serpentine

Distribution/Environment

The Sugar Pine-Lodgepole Pine/Dwarf Tanbark-Pacific Rhododendron type was found on the Gasquet Ranger District. Mean distance to the Pacific Ocean was 17.8 miles on these cool, lower one-third slope positions. Elevation averaged 2777 feet and ranged from 2100 to 3280 feet, lowest of all Sugar pine plant associations. Slopes were moderately steep (27%), northeast facing with the lowest radiation index (.397) in the sugar pine series.

Soil Summary

Soils in this type were derived from fine textured serpentiniteparent rocks. These rocks impart a neutral surface pH of 7.0 and subsurface pH of 7.0, highest in the sugar pine series. Soils were well drained, shallow (17%), moderately deep (66%), and deep (17%), gravelly loams, loams, and gravelly silt loams, with low AWC (2.4"), moderate A horizons (6"), and low A horizon coarse fragments (23%). They were found in the mesic and frigid soil temperature regime and were of very low productivity for conifer growth. The dominant soil families were fine-loamy, serpentinitic, mesic, Typic Haploxeralfs (33%) and loamy-skeletal, mixed, frigid, Typic Xerochrepts (50%).

Vegetation

Total vegetation cover was high and ranged from 85-99% with an average of 92%. Overstory cover of 38% was the highest of all sugar pine plant associations. The dominant overstory species was sugar pine (8%), with western white pine (5%) and Douglas-fir (5%) as occasional associates. Lodgepole pine (43%) dominates the lower layers. The regeneration layer included sugar pine (1%), Douglas-fir (1%), and western white pine (1%). The shrub layer was dense (82%) as a result of moist, cool sites. It included huckleberry oak (20%), Pacific rhododendron (14%), pinemat manzanita (10%), dwarf tanbark (30%), western azalea (5%), coffeeberry (3%), Pacific serviceberry (4%), and red huckleberry (8%). The forb layer was of moderate cover 10% and dominated by beargrass (9%), with occasional occurrences of white-veined wintergreen (1%). The grass layer was lacking, but when present often included heath woodrush (*Luzula comosa*) (1%).

Disturbance and Age Class Distribution

Stands found in this type ranged in age from 82 to 234 years with an average age of 147 years, youngest in the sugar pine series. The highest frequency of stands (83%) were found below 175 years of age. The frequency of stands below 200 years was 83%, no stands were found above 300 years stand age. This shift in stand age distribution towards younger stands indicates a high frequency of stand replacing fires have occurred, particularly in the period between 1820 and 1910. Fire intensity between 1910 and 1995 appears to have been restricted to low intensity, non-stand replacing events.

Stand Structure Summary

This type had an open mixture of uneven-aged, moderately tolerant tree species, from a variety of smaller diameter and younger age classes. The overstory was usually composed of at least two layers of different aged conifers. The top layer was dominated by sugar pine, while the second layer included western white pine, lodgepole pine, and Douglas-fir as associates with sugar pine.

The top layer had an average height of 91 feet and diameter of 23 inches. The

second layer had an average height of 45 feet and diameter of 12 inches.

Softwood cubic volume ranged from very low to low values with an average of 352 $ft.^3$ which is well below the average for all types in the sugar pine series (1,523 $ft.^3$). Basal area also ranged from very low to moderate with an average of 127 $ft.^2$, this was near the average for the series of 111 $ft.^2$. Dunning site class was 5 with site index of 75 at 300 years. Stand density index was moderate with an average of 302.

Successional Trends

The Sugar Pine-Lodgepole Pine/Dwarf Tanbark-Pacific Rhododendron type demonstrates the roll of lodgepole pine as an early seral dominant in this seral development sequence. Stand replacing fires appear to result in the reduction of sugar pine cover. In younger stands, sugar pine presence is often reduced to scattered predominants and large snags. This is due to the high cover of shrubs which during dry periods could contribute to high intensity fires of stand replacing nature. Repeated high intensity fires could lead to the elimination of the sugar pine seed source and hence alter the successional pathway. This scenario would favor fire related species such as lodgepole pine and knobcone pine. Low and moderate intensity fires would have a low probability of altering the successional pathway, due to the thick bark of sugar pine which is fire resistant. A more likely alteration of the successional pathway could result from mortality in the regeneration layer. Here, white pine blister rust kills young sugar pine with higher frequency than older trees. This would also favor other species such as lodgepole pine and knobcone pine.

Rare Plant Relationships

The rare plants Bolander's lily and Washington lily were found in this type. The moist environment along with the high cover of shrubs probably creates a micro-climate that is suitable for these species.

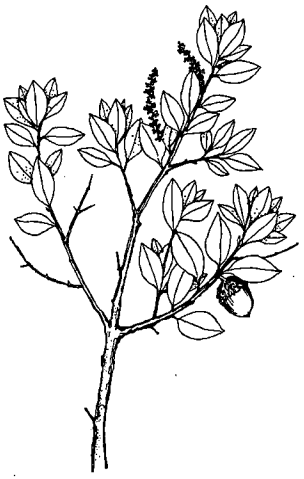
Management Implications

The Sugar Pine-Lodgepole Pine/Huckleberry Oak-Dwarf Tanbark type had a sparse overstory of very low productivity, with high mortality from white pine blister rust. It is not suitable for intensive forest management and has low suitability for salvage due to the low cover of sugar pine and its high value as wildlife habitat. Mortality of large sugar pine provides foraging as well as nesting habitat for a variety of cavity nesting birds. The dense shrub layer produces a variety of fruits and acorns that are favored by songbirds, deer, and bear.

Closely Related Types

The Sugar Pine-Lodgepole Pine/Dwarf Tanbark-Pacific Rhododendron type is often found downslope from the Sugar Pine-Lodgepole Pine/Huckleberry Oak-Dwarf Tanbark type, as well as the Western White Pine-Lodgepole Pine/Dwarf Tanbark-Pacific Rhododendron type. In nearby streamside positions and moist draws the Port-Orford cedar/Pacific Rhododendron-Salal type is often found.

Sugar Pine-Western White Pine/ Huckleberry Oak-Box-leaved Silk Tassel PILA-PIMO3/QUVA-GABU2 EcoCode CPSCPW11



huckleberry oak
(Quercus vaccinifolia)

box-leaved silk tassel
(Garrya buxifolia)

Sugar Pine-Western White Pine/Huckleberry Oak-Box-leaved Silk Tassel
PILA-PIMO3/QUVA-GABU2, EcoCode CPSCPW11

SUMMARY TABLE

(Sample size: 5)		COVER	CON
Tree Overstory Layer			
PILA	Sugar Pine	15	100
PIMO3	Western White PIne	10	100
PIJE	Jeffrey Pine	5	100
CADE3	Incense Cedar	5	80
Tree Understory Layer			
PIMO3	Western White PIne	2	100
CADE3	Incense Cedar	2	100
PILA	Sugar Pine	1	100
ABCO	White Fir	1	100
PIJE	Jeffrey Pine	2	60
Shrubs			
QUVA	Huckleberry Oak	54	100
GABU2	Dwarf Silktassel	8	100
VAPA	Red Huckleberry	7	100
RHCA2	Coffeeberry	5	100
Herbs & Grasses			
XETE	Beargrass	2	80
CHUMO	Western prince's pine	1	60
CAR1	Sedge	1	60

Environment

Elevation: 4420-4800 ft.

Aspect: N.E.

Slope: 5-50%

Slope Position: ridgetop & upper

Surface Rock: 40-75%

Soils

Pit Depth: 12-37"+

Coarse Fragments: 20-65%

Textures: xkl,vgl,gl

Parent Material: serpentinite& peridotite

Distribution/Environment

The Sugar Pine-Western White Pine/Huckleberry Oak-Dwarf Silktassel type was found on the Lower Trinity Ranger District. Mean distance to the Pacific Ocean was 21.2 miles in these upper one-third and ridgetop slope positions. Elevation averaged 4556 feet and ranged from 4420 to 4800 feet, highest of all Sugar pine plant associations. Slopes were very rocky (57%), moderately steep (29%), northeast facing with low radiation index (.410) as a result aspect.

Soil Summary

Soils in this type were derived from coarse and fine textured peridotite and serpentinite parent rocks. These rocks imparted a neutral surface and subsurface pH of 6.9. Soils were somewhat excessively drained, moderately deep (80%) and shallow (20%), extremely cobbly loams, very gravelly loams, and gravelly loams, with low AWC (1.4"), moderately thick A horizons (7"), and moderately high A horizon coarse fragments (42%). They were found in the frigid soil temperature regime and were poorly developed and of low productivity for conifer growth. The dominant soil families were loamy-skeletal, mixed, frigid, Typic Xerorthents (80%) and fine-loamy, serpentinitic, frigid, Lithic Xerochrepts (20%).

Vegetation

Total vegetation cover was high and ranged from 75-95% with an average of 89%. Overstory cover of 38% was low with sugar pine (15%) and western white pine (10%) as the codominant overstory species. Jeffrey pine (5%), incense cedar (5%), and Douglas-fir (5%) were occasional associates. The regeneration layer included sugar pine (1%), western white pine (2%), incense cedar (2%), Douglas-fir (1%), and Jeffrey pine (2%). The shrub layer was dense with an average cover of 74% and was dominated by huckleberry oak (54%). It also included red huckleberry (7%), pinemat manzanita (2%), coffeeberry (5%), dwarf silktassel (8%), Pacific serviceberry (2%), and whiteleaf manzanita (9%). The forb layer was of low cover 2% and included beargrass (2%), with occasional occurrences of iris (1%), western prince's pine (1%), and three-leaf anemone (*Anemone deltoidea*) (1%). The grass layer was of low cover, 1% and included occasional sedge species (1%).

Disturbance and Age Class Distribution

Stands found in this type ranged in age from 84 to 358 years with an average age of 258 years. The highest frequency of stands (80%) were found between 226 and 375 years of age. The frequency of stands above 300 years was 40% and the frequency of stands below 200 years was 20%. This shift in stand age towards dominance by older stands indicates that stand replacing fires have occurred less frequently in this type, particularly in the period between 1770 and 1995. Fire intensity in this period appears to have been restricted to low intensity, non-stand replacing events.

Stand Structure Summary

This type had a moderately open mixture of uneven-aged, moderately tolerant tree species, from a variety of diameter and age classes. The overstory was usually composed of at least two layers of different aged conifers. The top layer was dominated by sugar pine, while the second layer included western white pine, Jeffrey pine, and incense cedar as associates with sugar pine. The top layer had an average height of 74 feet and diameter of 26 inches. The second layer had an average height of 52 feet and diameter of 18 inches.

Softwood cubic volume ranged from very low to low values with an average of 808 $ft.^3$ which is well below the average for all types in the sugar pine series (1,523 $ft.^3$). Basal area also ranged from very low to low with an average of 75 $ft.^2$, this was also well below the average for the series of 111 $ft.^2$. Dunning site class was 5 with site index of 75 at 300 years. Stand density index was the lowest in the sugar pine series with an average of 144.

Successional Trends

The Sugar Pine-Western White Pine/Huckleberry Oak-Dwarf Silktassel type has a moderate potential for alteration of its successional pathway with continued fire suppression. This is due to the high cover of shrubs which during dry periods would contribute to fires of stand replacing intensity. Repeated high intensity fires could lead to the elimination of the sugar pine seed source and hence alter the successional pathway. The low frequency of stand replacing fires probably account for the presence of western white pine in these stands. The probability of sugar pine loss due to these fires is low due to the thick bark of sugar pine which is fire resistant. A more likely alteration of the successional pathway could result from mortality in the regeneration layer. Here, white pine blister rust kills young sugar pine with higher frequency than older trees. This would also favor other species such as Jeffrey pine and incense cedar.

Rare Plant Relationships

The rare plant Washington lily was identified in this type. It appears to do best in areas where shrub cover is high. This may be due to the micro-climate under the shrubs and/or the avoidance of herbivory from the high numbers of deer and bear utilizing this type.

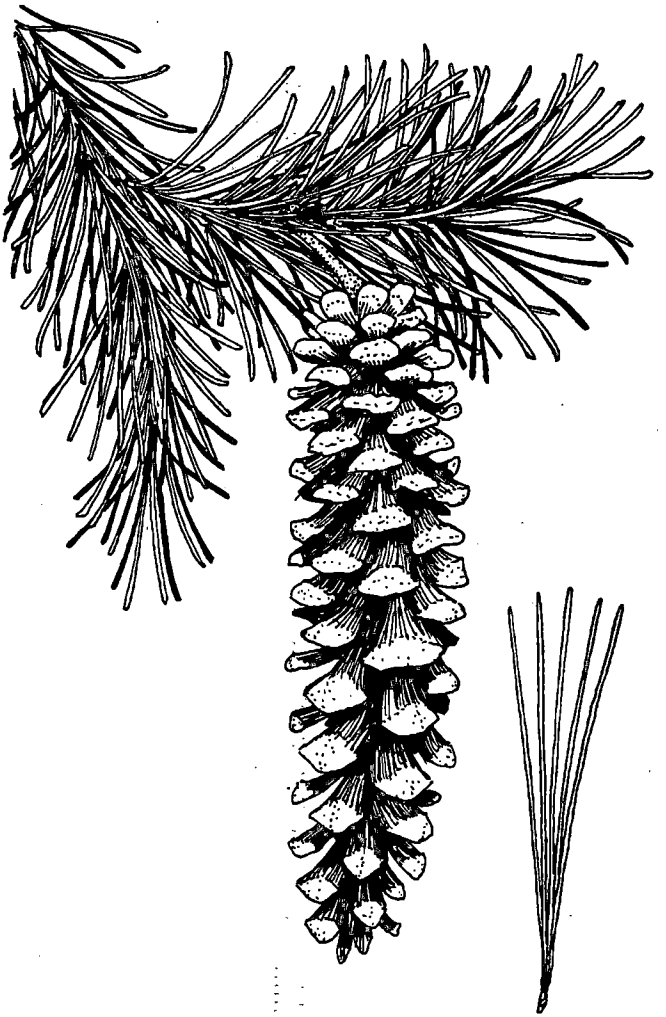
Management Implications

The Sugar Pine-Western White Pine/Huckleberry Oak-Dwarf Silktassel type had a sparse overstory of low productivity, with high mortality from white pine blister rust. It is not suitable for intensive forest management or salvage due to the low number of trees and the importance of maintaining organic material on these deficient sites. Surface rock cover is the highest in the sugar pine series and would make planting a difficult or impossible task. The dense shrub layer is of high value due to its production of a variety of fruits and acorns that are favored by songbirds, deer, and bear.

Closely Related Types

The Sugar Pine-Western White Pine/Huckleberry Oak-Dwarf Silktassel type is often found downslope from the Jeffrey Pine/Huckleberry Oak-Pinemat Manzanita/Idaho Fescue type, upslope from the Douglas-fir/Huckleberry Oak type and adjacent to Jeffrey Pine-Incense Cedar/Huckleberry Oak/Beargrass type.. The former type is found on ridgetop sites with shallower soils and lower productivity. The latter type has deeper soils and higher productivity. The Port-Orford cedar/Western Azalea type is also found in close proximity to the Sugar Pine-Western White Pine/Huckleberry Oak-Dwarf Silktassel type in streamside positions. The closely related Sugar Pine-Lodgepole Pine/ Huckleberry Oak-Dwarf Tanbark type replaces this type in coastal positions.

Western White Pine Series



INTRODUCTION TO THE WESTERN WHITE PINE SERIES

The western white pine series was described using 30 ecology plots distributed within Del Norte County, where the greatest extent of serpentine soils were found (figure1). Other western white pine plant associations likely occur in Siskiyou County but they have not yet been sampled.

Analysis of the western white pine sample data identified three subseries, containing three plant associations (Table 9). They were arrayed along temperature/moisture gradients (figure 16) and differed from one another by soil temperature, slope, litter, surface gravel and rock. All sites were located in close proximity to the Pacific Ocean which influenced soil temperature, particularly on sites with gentle slopes where cold air and heavy snow packs tended to accumulate. Sites were mostly rocky, with ridgetop positions having significantly higher surface rock and gravel and lower litter cover. They were key variables in discriminating between plant associations due to there influence on moisture conditions. Soils in ridgetop or spur ridge positions were of lower development than those in lower slope positions due to continuous soil loss in ridgetop sites versus accumulation in lower slope positions. This was verified by the higher frequency of Entisols in the ridgetop slope positions.

Plant associations in the western white pine series were arranged along the environment gradients described above as follows. The Western White Pine-Lodgepole Pine/Dwarf Tanbark-Pacific Rhododendron type was found on cool, moist sites, with gentle slopes and high winter snowpacks. It was followed on warmer adjacent sites with better air drainage by the Western White-Sugar Pine/Huckleberry Oak-Dwarf Tanbark type and on slightly higher, cool sites, with high surface rock and gravel by the Western White Pine-Douglas-fir/ Huckleberry Oak-Dwarf Tanbark type.

Productivity was very low to low in all western white pine plant associations as a result of parent material, soils, and slope position. Stand structure also varied by plant association. The Western White Pine-Sugar Pine/Huckleberry Oak-Dwarf Tanbark type had the tallest mean tree height in the top and second layers with means of 73 and 54 feet. It also had the largest mean diameter in the top layer 22 inches dbh and largest diameter in the second layer 13 inches dbh. In contrast, the Western White Pine-Lodgepole Pine/ Dwarf Tanbark-Pacific Rhododendron and the Western White Pine-Douglas-fir/ Huckleberry Oak-Dwarf Tanbark types had the shortest mean tree height of 48 feet in the top layer and smallest mean diameters of 13 and 11 inches dbh.

Vegetation composition reflects the environments described above. For instance, the Western White Pine-Lodgepole Pine/Dwarf Tanbark-Pacific Rhododendron type was found on cool, moist, mid elevation sites. Pacific rhododendron was the indicator species. It distinguishes this plant association from all others in the series. Mesic indicator species in the western white pine series included inside-out flower and dwarf tanbark. Wet indicator species included Pacific rhododendron and western azalea. Dry indicator species include huckleberry oak, dwarf silktassel, whiteleaf manzanita, and creeping Oregon-grape. Cool, high elevation site indicators included western white pine and lodgepole pine.

Table 9 . Plant associations found in the Western White Pine Series.

EDP CODE	PLANT ASSOCIATION NAME
PIMO3-PICO1 Subseries	Western White Pine-Lodgepole Pine
PIMO3-PICO1/LIDEE-RHMA	Western White Pine-Lodgepole Pine/ Dwarf Tanbark-Pacific Rhododendron
PIMO3-PILA Subseries	Western white Pine-Sugar Pine
PIMO3-PILA/QUVA-LIDEE	Western White Pine-Sugar Pine/ Huckleberry Oak-Dwarf Tanbark
PIMO3-PSME Subseries	Western White Pine-Douglas-fir
PIMO3-PSME/QUVA-LIDEE	Western White Pine-Douglas-fir/ Huckleberry Oak-Dwarf Tanbark

Age class distribution was used here as an indicator of disturbance in the form of stand replacing fires. The highest frequency of stand replacing fires, based on youngest mean stand age and highest frequency of stands below 200 years stand age, was the Western White Pine-Lodgepole Pine/Dwarf Tanbark-Pacific Rhododendron type. It has a dense shrub layer that provides ladder fuels that tend to contribute to stand replacing fires. Lodgepole pine is included in the name of this plant association based on it's early seral dominance. It was followed in stand replacing fire frequency by the Western White Pine-Douglas-fir/ Huckleberry Oak-Dwarf Tanbark type. The lowest frequency of stand replacing fires occurred in the Western White Pine-Sugar Pine/Huckleberry Oak-Dwarf Tanbark type.

The western white pine series had a moderate frequency of sensitive and rare plants. It included the sensitive species Oregon bleeding heart, Waldo buckwheat, serpentine jewelflower, and the rare species serpentine arnica, Klamath arnica (*Arnica spathulata*), Howell's horkelia, Del Norte County iris, Bolander's lily, Howell's lomatium, Howell's sandwort, timber bluegrass, Peck's sanicle, Siskiyou Mountain ragwort, yellow inside-out flower and Del Norte pea (*Lathyrus delnorticus*) have been identified within its plant associations.

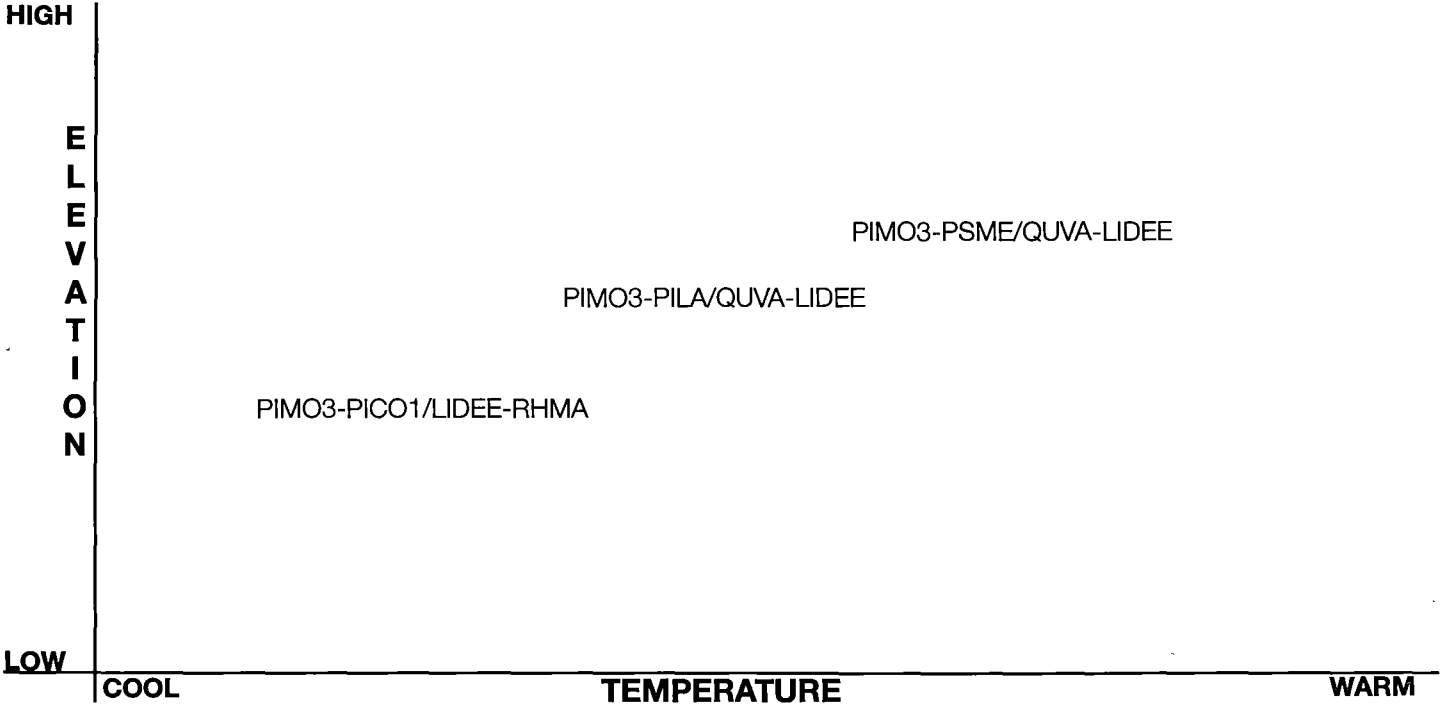


FIGURE 16. Relative relationships of plant association in the Western White Pine Series based on elevation and temperature.

Western White Pine Series Key

1 a. Huckleberry oak and dwarf tanbark present 2

2 a. Pacific rhododendron cover ≥ 5% PIMO3-PICO1/LIDEE-RHMA

2 b. Pacific rhododendron absent or not as above 3

3 a. Sugar pine cover ≥ 5% PIMO3-PILA/QUVA-LIDEE

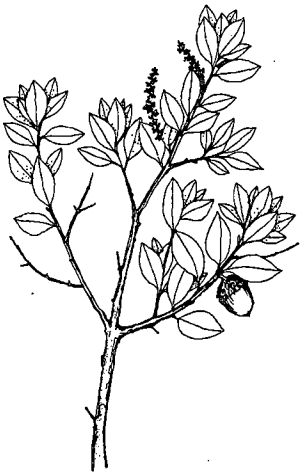
3 b. Sugar pine absent or not as above 4

4 a. Douglas-fir cover ≥ 5% PIMO3-PSME/QUVA-LIDEE

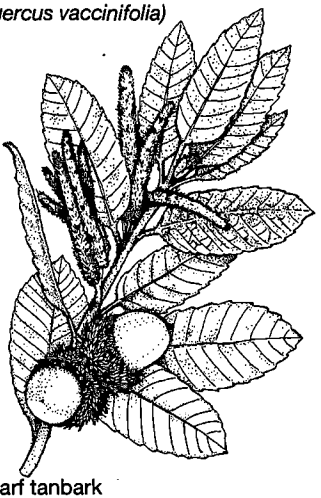
4 b. Douglas-fir absent or not as above .. go back and try again.

1 b. Not as above ..... Return to Step 1 and try again.

Western White Pine-Sugar Pine/ Huckleberry Oak-Dwarf Tanbark PIMO3-PILA/QUVA-LIDEE EcoCode CPWCPS11



huckleberry oak
(Quercus vaccinifolia)



dwarf tanbark
(Lithocarpus densiflorus ssp. *echinoides)*

Western White Pine-Sugar Pine/Huckleberry Oak-Dwarf Tanbark
PIMO3-PILA/QUVA-LIDEE, EcoCode CPWCPS11

SUMMARY TABLE

(Sample size: 10)		COVER	CON
Tree Overstory Layer			
PILA	Sugar Pine	11	100
PIMO3	Western White Pine	24	90
PSME	Douglas-fir	6	60
Tree Understory Layer			
PILA	Sugar Pine	3	100
PIMO3	Western White Pine	4	90
PSME	Douglas-fir	1	60
Shrubs			
QUVA	Huckleberry Oak	34	100
VAPA	Red Huckleberry	16	100
LIDEE	Dwarf Tanbark	15	90
ARNE2	Pinemat Manzanita	15	90
RHCA	Coffeeberry	5	90
BERE	Creeping Oregongrape	2	90
Herbs & Grasses			
XETE	Beargrass	12	100
WHMO	Western modesty	4	60

Environment

Elevation: 2200-3820 ft.

Aspect: E., W.

Slope: 7-55%

Slope Position: upper and middle 1/3

Surface Rock: 1-67%

Soils

Pit Depth: 22-40"+

Coarse Fragments: 15-60%

Textures: l,gl,vgl

Parent Material: serpentine

Distribution/Environment

The Western White Pine-Sugar Pine/Huckleberry Oak-Dwarf Tanbark type was found on the Gasquet Ranger District. Mean distance to the Pacific Ocean was 14.8 miles in these upper and middle one-third slope positions. Elevation averaged 3249 feet and ranged from 2200 to 3820 feet. Slopes had high surface rock (34%) and were moderately steep (30%), east and west facing with moderate radiation index (.470) as a result aspect.

Soil Summary

Soils in this type were derived from fine textured serpentiniteparent rocks. These rocks imparted a neutral surface pH of 6.8 and subsurface pH of 7.1. Soils were well drained, moderately deep (40%) and deep (50%), loams, gravelly loams and very gravelly loams, with low AWC (2.3"), moderate A horizons (6"), and moderate A horizon coarse fragments (35%). They were found in the mesic and frigid soil temperature regimes and were of low productivity for conifer growth. The dominant soil families were fine-loamy or loamy-skeletal, mixed or serpentinitic, mesic, Typic Haploxeralfs (70%) and loamy-skeletal, mixed, frigid, Typic Xerorthents (20%).

Vegetation

Total vegetation cover was high and ranged from 90-99% with an average of 95%. Overstory cover of 37% was low with western white pine (24%) and sugar pine (11%) as the codominant overstory species. Douglas-fir (6%), lodgepole pine (2%), and knobcone pine (2%) were occasional associates. The regeneration layer was dominated by western white pine (4%) and sugar pine (3%), with Douglas-fir (1%) as a frequent associate. The shrub layer was dense with an average cover of 84%, highest in the western white pine series. It was composed of a variety of species and included huckleberry oak (34%), red huckleberry (16%), pinemat manzanita (15%), dwarf tanbark (15%), Coffeeberry (5%), Pacific serviceberry (3%), dwarf silktassel (7%), common juniper (3%), creeping Oregon-grape (2%), whiteleaf manzanita (9%), and California bay (5%). The forb layer was of moderate cover 16% and was dominated by beargrass (12%), with occasional occurrences of Western modesty (4%), iris (3%), western prince's pine (1%), Bolander's lily (1%), and white-veined wintergreen (1%). The grass layer was of low cover, 1% and included California fescue.

Disturbance and Age Class Distribution

Stands found in this type ranged in age from 76 to 317 years with an average age of 171 years. The highest frequency of stands (40%) were found in the 126 to 175 years of age class. The frequency of stands above 300 years was 10% and the frequency of stands below 200 years was 60%. This dominance by younger stands indicates that stand replacing fires have occurred with regularity, particularly in the period between 1770 and 1920. Fire intensity between 1920 and 1995 appear to have been restricted to low intensity, non-stand replacing events.

Stand Structure Summary

This type had a moderately open mixture of uneven-aged, moderately tolerant tree species, from a variety of diameter and age classes. The overstory was usually composed of at least two layers of different aged conifers. The top layer was dominated by western white pine and sugar pine, while the second layer included Douglas-fir, lodgepole pine, and knobcone pine as associates

with western white pine. The top layer had an average height of 73 feet and diameter of 19 inches. The second layer had an average height of 54 feet and diameter of 13 inches.

Softwood cubic volume ranged from very low to low values with an average of 1,217 $ft.^3$ which is just above the average for all types in the western white pine series (1,090 $ft.^3$). Basal area also ranged from very low to moderate with an average of 95 $ft.^2$, this was also below the average for the series of 122 $ft.^2$. Dunning site class was 5 with site index of 75 at 300 years. Stand density index was the lowest in the western white pine series with an average of 177.

Successional Trends

The Western White Pine-Sugar Pine/Huckleberry Oak-Dwarf Tanbark type has a moderate potential for alteration of its successional pathway with continued fire suppression. This is due to the high cover of shrubs which during dry periods would contribute to fires of stand replacing intensity. Repeated high intensity fires could lead to the elimination of the sugar pine seed source and hence alter the successional pathway. This scenario would favor fire related species such as lodgepole pine and knobcone pine which tend to dominate the early seral stages after stand replacing fires. Low and moderate intensity fires probably account for the presence of these fire related species in these stands. Loss of large sugar pine due to these fires is low due to the thick bark of sugar pine which is fire resistant. A more likely alteration of the successional pathway could result from mortality in the regeneration layer. Here, white pine blister rust kills young western white pine and sugar pine with higher frequency than older trees. This would also favor other species such as lodgepole pine and knobcone pine.

Rare Plant Relationships

The sensitive plants Oregon bleeding heart and Waldo buckwheat and the rare plants Bolander's lily, Howell's lomatium, Howell's sandwort, timber bluegrass, Peck's sanicle and Siskiyou Mountain ragwort were identified in this type. Bolander's lily appeared scattered in the dense shrub layer. This may be due to the micro-climate under the shrubs or the protection afforded by the shrubs against deer and bear herbivory.

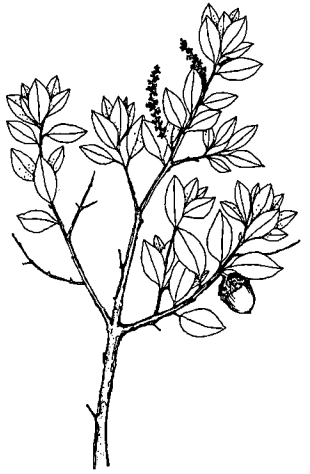
Management Implications

The Western White Pine-Sugar Pine/Huckleberry Oak-Dwarf Tanbark type had a sparse overstory of low productivity, with high mortality from white pine blister rust. It is not suitable for intensive forest management or salvage due to its low tree cover, small trees, and high decay rate. The dense shrub layer produces a variety of fruits and acorns that are favored by songbirds, deer, and bear.

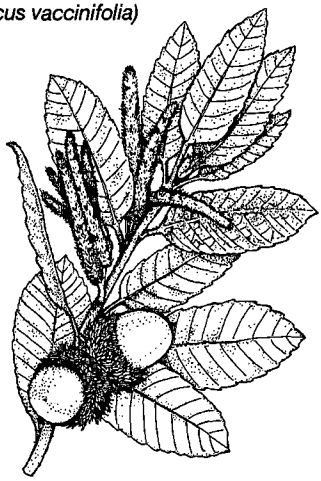
Closely Related Types

The Western White Pine-Sugar Pine/Huckleberry Oak-Dwarf Tanbark type is often found in close proximity to the Sugar Pine-Lodgepole Pine/Huckleberry Oak-Dwarf Tanbark type. The former type is found on cool sites with deeper soils and poor air drainage. The latter type has shallower soils and warmer aspects. The Port Orford cedar/Western Azalea type is also found in close proximity to the Western White Pine-Sugar Pine/ Huckleberry Oak-Dwarf Tanbark type in streamside positions.

Western White Pine-Douglas-fir/ Huckleberry Oak-Dwarf Tanbark PIMO3-PSME/QUVA-LIDEE EcoCode CPWCD011



huckleberry oak
(Quercus vaccinifolia)



dwarf tanbark
(Lithocarpus densiflorus ssp. *echinoides)*

Western White Pine-Douglas-fir/Huckleberry Oak-Dwarf Tanbark
PIMO3-PSME/QUVA-LIDEE, EcoCode CPWCD011

SUMMARY TABLE

(Sample size: 10)

		COVER	CON
Tree Overstory Layer			
PIMO3	Western White Pine	20	80
PICO1	Lodgepole Pine	32	80
PSME	Douglas-fir	5	60
Tree Understory Layer			
PIMO3	Western White Pine	5	80
PSME	Douglas-fir	1	60
PICO1	Lodgepole Pine	1	70
Shrubs			
QUVA	Huckleberry Oak	33	90
LIDEE	Dwarf Tanbark	13	90
ARNE2	Pinemat Manzanita	17	90
VAPA	Red Huckleberry	8	90
Herbs & Grasses			
XETE	Beargrass	7	90
PYPI	White-veined wintergreen	1	60
WHMO	Western modesty	3	60
FEID	Idaho Fescue	5	50
FECA	California Fescue	6	40

Environment

Elevation: 2700-4100 ft.

Aspect: S., E., W.

Slope: 20-65%

Slope Position: ridgetop & upper 1/3

Surface Rock: 50-95%

Soils

Pit Depth: 20-40"+

Coarse Fragments: 10-50%

Textures: stcl,gcl,gl

Parent Material: serpentine

Distribution/Environment

The Western White Pine-Douglas-fir/Huckleberry Oak-Dwarf Tanbark type was found on the Gasquet Ranger District. Mean distance to the Pacific Ocean was 18.0 miles in these upper one-third and ridgetop slope positions. Elevation averaged 3522 feet and ranged from 2700 to 4100 feet, highest of all western white pine plant associations. Slopes were extremely rocky (74%), moderately steep (34%), south, east, and west facing with moderate radiation index (.470) as a result aspect.

Soil Summary

Soils in this type were derived from fine textured serpentinite parent rocks. These rocks imparted a neutral surface pH of 6.9 and subsurface pH of 7.0. Soils were well drained, moderately deep (45%), deep (45%), and shallow (10%), gravelly clay loams, stony clay loams, and sandy loams, with low AWC (2.1"), moderately thick A horizons (5"), and moderately high A horizon coarse fragments (32%). They were found in the mesic and frigid soil temperature regimes and were of low productivity for conifer growth. The dominant soil families were loamy-skeletal, serpentinitic, mesic, Typic Haploxeralfs (50%), loamy-skeletal, serpentinitic, mesic, Typic Xerochrepts (30%), and fine-loamy, mixed, frigid, Typic Xerorthents (20%).

Vegetation

Total vegetation cover was high and ranged from 80-99% with an average of 88%. Overstory cover of 43% was moderate with western white pine (20%) as the dominant overstory conifer. Lodgepole pine (32%), and Douglas-fir (5%) were the codominant species in the second layer. The regeneration layer included western white pine (5%), lodgepole pine (1%), and Douglas-fir (1%). The shrub layer was dense with an average cover of 67% and was dominated by huckleberry oak (33%), dwarf tanbark (13%), and pinemat manzanita (7%). It also included red huckleberry (8%), Coffeeberry (5%), dwarf silktassel (4%), Pacific serviceberry (1%), common juniper (5%), squawcarpet (6%), and creeping Oregon-grape (1%). The forb layer was of moderate cover 10% and included beargrass (7%), with frequent occurrences of white veined wintergreen (1%), Western modesty (4%), and iris (2%). The grass layer was of moderate cover, 6% and included frequent occurrences of California fescue (6%), Idaho fescue (5%), and sedge species (4%).

Disturbance and Age Class Distribution

Stands found in this type ranged in age from 57 to 204 years with an average age of 124 years. The highest frequency of stands (60%) were less than 175 years of age. The frequency of stands below 200 years was 90%, no stands were identified above 300 years of age. This dominance by younger stands indicates that stand replacing fires have occurred frequently in this type, particularly in the period between 1820 and 1935. Fire intensity in the period between 1935 and 1995 appears to have been restricted to low intensity, non-stand replacing events.

Stand Structure Summary

This type had a moderately open mixture of stunted, small, uneven-aged, moderately tolerant tree species. The overstory was usually composed of at least two layers of different aged conifers. The top layer was dominated by western white pine, while the second layer was dominated by lodgepole pine. The top layer had an average height of 48 feet and diameter of 11 inches. The

second layer had an average height of 43 feet and diameter of 12 inches.

Softwood cubic volume ranged from very low to low values with an average of 1258 $ft.^3$ which is just above the average for all types in the western white pine series (1,090 $ft.^3$). Basal area also ranged from very low to moderate with an average of 142 $ft.^2$, this was also above the average for the series of 122 $ft.^2$. Dunning site class was 5 with site index of 75 at 300 years. Stand density index was the highest in the western white pine series with an average of 379.

Successional Trends

The Western White Pine-Douglas-fir/Huckleberry Oak-Dwarf Tanbark type has a moderate potential for alteration of its successional pathway with continued fire suppression. This is due to the high cover of shrubs which during dry periods would contribute to fires of stand replacing intensity. Repeated high intensity fires could lead to the reduction or elimination of the western white pine and Douglas-fir seed source and favor lodgepole pine. A more likely alteration of the successional pathway could result from mortality in the regeneration layer. Here, white pine blister rust kills young western white pine with higher frequency than older trees. This would also favor other species such as lodgepole pine and Douglas-fir.

Rare Plant Relationships

The sensitive plants Oregon bleeding heart and Waldo buckwheat along with the rare plants serpentine arnica. Klamath arnica, Howell's horkelia, Del Norte County iris, timber bluegrass, yellow inside-out flower, Peck's sanicle, Siskiyou Mountain ragwort, Del Norte pea, and Bolander's lily were found in this type.

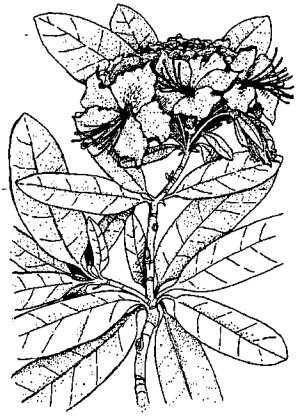
Management Implications

The Western White Pine-Douglas-fir/Huckleberry Oak-Dwarf Tanbark type had a sparse overstory of low productivity, with high mortality from white pine blister rust. It is not suitable for intensive forest management or salvage due to the low number of trees and their size as well as their tendency toward rapid decay. Surface rock cover is the highest in the western white pine series and would make planting a difficult or impossible task. The dense shrub layer is of high value due to its production of a variety of fruits and acorns that are favored by songbirds, deer, and bear.

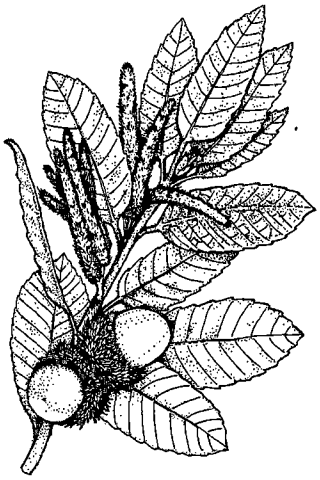
Closely Related Types

The Western White Pine-Douglas-fir/Huckleberry Oak-Dwarf Tanbark type is closely related to the Western White Pine-Sugar Pine/Huckleberry Oak-Dwarf Tanbark type. They differ in percent surface rock, softwood basal area and stand density.

Western White Pine-Lodgepole Pine/ Dwarf Tanbark-Pacific Rhododendron PIMO3-PICO1/LIDEE-RHMA EcoCode CPWCPL11



Pacific rhododendron
(Rhododendron macrophyllum)



dwarf tanbark
(Lithocarpus densiflorus ssp. *echinoides)*

Western White Pine-Lodgepole/Dwarf Tanbark-Pacific Rhododendron PIMO3-PICO1/LIDEE-RHMA, EcoCode CPWCPL11

SUMMARY TABLE

(Sample size: 10)		COVER	CON
Tree Overstory Layer			
PIMO3	Western White Pine	21	100
PICO1	Lodgepole Pine	30	80
PSME	Douglas-fir	5	60
Tree Understory Layer			
PIMO3	Western White Pine	4	90
PICO1	Lodgepole Pine	4	60
PSME	Douglas-fir	1	50
Shrubs			
QUVA	Huckleberry Oak	12	100
VAPA	Red Huckleberry	10	100
LIDEE	Dwarf Tanbark	31	90
RHMA	Pacific Rhododendron	16	90
RHCA	Coffeeberry	6	90
HODI	Ocean Spray	3	90
RHOC	Western Azalea	11	70
Herbs & Grasses			
XETE	Beargrass	19	100
PYPI	White-veined wintergreen	2	50
WHMO	Western modesty	2	40

Environment

Elevation: 1800-3800 ft.

Aspect: N., S., W.

Slope: 2-28%

Slope Position: upper and middle 1/3

Surface Rock: 3-55%

Soils

Pit Depth: 14-40"+

Coarse Fragments: 10-40%

Textures: gl,vgl

Parent Material: serpentine

Distribution/Environment

The Western White Pine-Lodgepole Pine/Dwarf Tanbark-Pacific Rhododendron type was found on the Gasquet Ranger District. Mean distance to the Pacific Ocean was 15.2 miles on these cool, upper and middle one-third slope positions. Elevation averaged 3088 feet and ranged from 1800 to 3800 feet, lowest of all western white pine plant associations. Slopes were linear, gentle (17%), north, south, and west facing with the lowest radiation index (.460) in the western white pine series.

Soil Summary

Soils in this type were derived from fine textured serpentiniteparent rocks. These rocks impart a neutral surface pH of 6.8 and subsurface pH of 7.1. Soils were well drained, shallow (20%), moderately deep (40%), and deep (40%), gravelly loams and very gravelly loams, with moderate AWC (2.6"), moderate A horizons (6"), and moderate A horizon coarse fragments (30%). They were found in the mesic and frigid soil temperature regime and were of very low productivity for conifer growth. The dominant soil families were fine-loamy, serpentinitic, mesic, Typic Haploxeralfs (50%) and loamy-skeletal, serpentinitic, mesic or frigid, Typic Xerochrepts (50%).

Vegetation

Total vegetation cover was high and ranged from 80-99% with an average of 94%. Overstory cover of 48% was the highest of all western white pine plant associations. The dominant overstory species were western white pine (21%), with Douglas-fir (5%) as an occasional associate. Lodgepole pine (30%) dominated the lower layers and early seral stages. The regeneration layer was dominated by western white pine (4%), lodgepole pine (4%), and Douglas-fir (1%). The shrub layer was dense (77%) as a result of moist, cool sites. It included huckleberry oak (12%), Pacific rhododendron (16%), pinemat manzanita (16%), dwarf tanbark (31%), ocean spray (3%), western azalea (11%), Coffeeberry (6%), Pacific serviceberry (2%), common juniper (6%), and red huckleberry (10%). The forb layer was of high cover 23% and dominated by beargrass (19%), with occasional occurrences of white veined wintergreen (2%), western modesty (2%), inside-out flower (5%), and California harebell (1%). The grass layer was lacking 2%, but when present often included California fescue (2%) and sedge (2%).

Disturbance and Age Class Distribution

Stands found in this type ranged in age from 58 to 231 years with an average age of 113 years, youngest in the western white pine series. The highest frequency of stands (70%) were found below 175 years of age. The frequency of stands below 200 years was 90%, no stands were found above 300 years stand age. This shift in stand age distribution towards younger stands indicates a high frequency of stand replacing fires have occurred, particularly in the period between 1820 and 1935. Fire intensity between 1935 and 1995 appears to have been restricted to low intensity, non-stand replacing events.

Stand Structure Summary

This type had an open mixture of stunted, small, uneven-aged, moderately tolerant tree species, from a variety of smaller diameter and younger age classes. The overstory was usually composed of at least two layers of different aged conifers. The top layer was dominated by western white pine, while the second layer included western white pine, lodgepole pine, and Douglas-fir as

associates with western white pine. The top layer had an average height of 48 feet and diameter of 13 inches. The second layer had an average height of 40 feet and diameter of 8 inches.

Softwood cubic volume ranged from very low to low values with an average of 890 $ft.^3$ which is below the average for all types in the sugar pine series (1,090 $ft.^3$). Basal area also ranged from very low to moderate with an average of 130 $ft.^2$, this was near the average for the series of 122 $ft.^2$. Dunning site class was 5 with site index of 75 at 300 years. Stand density index was moderate with an average of 304.

Successional Trends

The Western White Pine-Lodgepole Pine/Dwarf Tanbark-Pacific Rhododendron type demonstrates the roll of lodgepole pine as an early seral dominant in this seral development sequence. Stand replacing fires appear to result in the reduction of western white pine cover. In younger stands, western white pine presence is often reduced to scattered predominant and medium snags. This is due to the high cover of shrubs which during dry periods could contribute to high intensity fires of stand replacing nature. Repeated high intensity fires could lead to the reduction or elimination of the western white pine seed source and hence alter the successional pathway. This scenario would favor fire related species such as lodgepole pine and knobcone pine. Low and moderate intensity fires would have a low probability of altering the successional pathway. A more likely alteration of the successional pathway could result from mortality in the regeneration layer. Here, white pine blister rust kills young western white pine with higher frequency than older trees. This would also favor other species such as lodgepole pine and knobcone pine.

Rare Plant Relationships

The sensitive plant Howell's jewelflower, along with the rare plants Howell's horkelia, Del Norte County iris, Washington lily, yellow inside-out flower, Siskiyou Mountain ragwort, and Bolander's lily were found in this type.

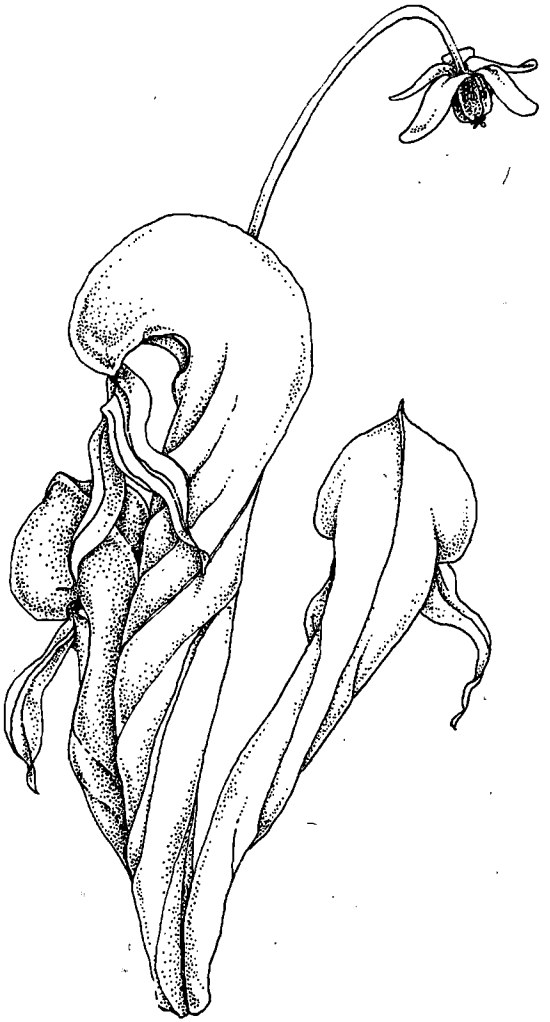
Management Implications

The Western White Pine-Lodgepole Pine/Huckleberry Oak-Dwarf Tanbark type had a sparse overstory of very low productivity, with high mortality from white pine blister rust. It is not suitable for intensive forest management and has low suitability for salvage due to species composition and tree size. Mortality of western white pine provides foraging habitat for a variety of birds. The dense shrub layer produces a variety of fruits and acorns that are favored by songbirds, deer, and bear.

Closely Related Types

The Western White Pine-Lodgepole Pine/Dwarf Tanbark-Pacific Rhododendron type is often found upslope from the Sugar Pine-Lodgepole Pine/Huckleberry Oak-Dwarf Tanbark type, as well as the Western White Pine-Lodgepole Pine/Huckleberry Oak-Dwarf Tanbark type. In nearby streamside positions and moist draws the Port-Orford cedar/Pacific Rhododendron-Salal type is often found.

Special Habitats

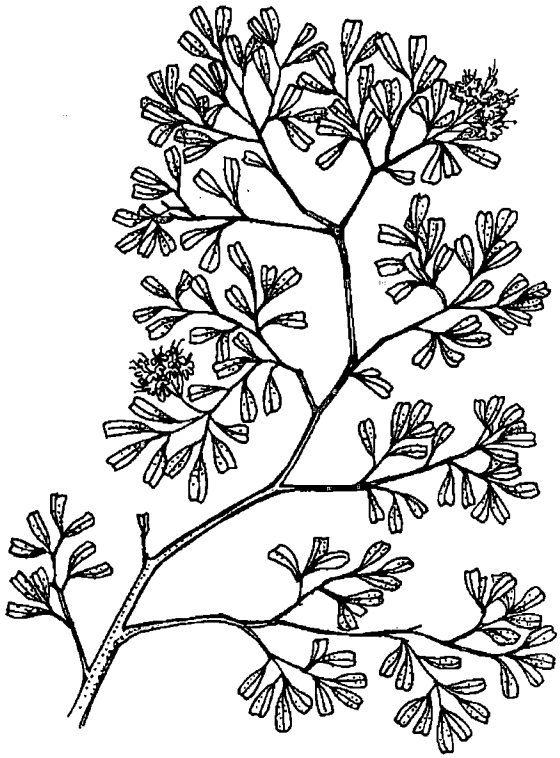


INTRODUCTION TO SPECIAL HABITATS

The special habitats described in this section were limited in extent but extremely important, particularly as a source of biodiversity. These special habitats, included serpentine barrens and bogs. To date, only two plant associations, the Siskiyou Mat/Idaho Fescue//Serpentine Barrens and the California Pitcher Plant//Bog type have been described. However, more are expected after an extensive review of these special habitats. Twenty ecology plots distributed within Del Norte County were utilized to develop descriptions of these types. They were arrayed along a moisture gradient and differed from one another by slope position, slope shape, and available water. The Siskiyou Mat/Idaho Fescue//Serpentine Barrens type was found on convex shaped, ridgetop or spur ridge positions where moisture conditions were the driest of all plant associations in this field guide. They had the highest frequency of sensitive and rare plants of all types described in this guide. In contrast, the California Pitcher Plant //Bog type was found at the other extreme, on cool, wet, concave shaped sites in the lower and middle one-third slope positions. It had the second highest frequency of sensitive and rare plants. Future sampling will likely add additional plant associations in these special habitats. For example, an additional serpentine barren habitat has been recognized in the Lassics, which includes the sensitive plants, two flowered pea, Lassic's sandwort and Lassic's lupine along with the rare plant Hoffman's onion.

Vegetation composition reflects the environments described above. For instance, the California Pitcher Plant //Bog type was characterized by the presence of California pitcher plant on these cool, wet, streamside sites, or sites with subsurface water flow. The Siskiyou Mat/Idaho Fescue//Serpentine Barrens type was characterized by its warm, dry ridgetop positions with low vegetation cover and high percent of exposed bare ground, gravel and rock.

Siskiyou Mat/Idaho Fescue//
Serpentine Barrens
CEPU-1/FEID//Serpentine Barrens
Association
EcoCode SCPSBS11



Siskiyou Mat
(Ceanothus pumilus)

Siskiyou Mat/Idaho Fescue//Serpentine Barrens CEPU-1/FEID//Serpentine Barrens Association, EcoCodeSCPSBS11

SUMMARY TABLE

(Sample Size:10)		COVER	CON
Tree Overstory Layer			
PIJE	Jeffrey Pine	4	60
Tree Understory Layer			
PIJE	Jeffrey Pine	1	60
Shrubs			
CEPU	Siskiyou Mat	3	100
JUCOS	Common Juniper	4	80
ARNE2	Pinemat Manzanita	9	60
QUVA	Huckleberry Oak	4	60
Herbs & Grasses			
FEID	Idaho Fescue	16	100
CACO	Northwestern Sedge	4	90
VICU	Wedgeleaf Violet	2	70
HOSE	Howell's Horkelia	7	80

ENVIRONMENT

Elevation: 1560-4000ft.
Aspect: N.,S.W.,S.E.
Slope:2-40%
Slope Position: ridgetop & lower1/3
Surface Rock:2-40%

SOILS

Pit Depth: 2-11"
Coarse Fragments: 10-40%
Textures:l, sl, gsl, vgl, vgsl, vkl
Parent Material: serpentine

Distribution/Environment

This type was named Siskiyou Mat/Idaho Fescue//Serpentine Barrens due to its primary characteristic of bare serpentine soil and rock and the presence of Siskiyou Mat and Idaho fescue. It was found on the Gasquet Ranger District in ridgetop and spur ridge slope positions. Elevation averaged 2904 feet and ranged from 1560 to 4000 feet. Slopes were gentle (23%), with convex and linear shapes, south and west facing with high radiation index (.500) and had high surface rock (35%).

Soil Summary

Soils in this type were derived from fine textured serpentine parent rocks. These rocks imparted a neutral surface and sub-surface pH of 6.9. Soils were well drained, shallow (100%), loams, gravelly loams and very gravelly sandy loams, with very low AWC (0.3"), thin A horizons (3"), and moderate A horizon coarse fragments (34%). They were found in the mesic and frigid soil temperature regimes and were of very low productivity for vegetation growth. The dominant soil family was loamy, mixed or serpentinitic, mesic, Lithic Xerorthents.

Vegetation

Total vegetation cover ranged from very low (14%) to high (96%) with an average of 63%. Overstory cover of 3% was below the minimum for consideration as forested, 10%. It included occasional occurrences of Jeffrey pine (4%). The shrub layer was also of low cover with an average cover of 16%. It was dominated by Siskiyou Mat (3%) and running juniper (4%), with occasional occurrences of huckleberry oak (4%), pinemat manzanita (9%), and boxleaf silktassel (2%). The forb layer was of moderate cover 20% and was dominated by Howell's horkelia (7%) and wedgeleaf violet (Viola cuneata) (2%), with occasional occurrences of ternate buckwheat (*Eriogonum ternatum*) (2%), opposite-leaved lewisia (*Lewisia oppositifolia*) (1%), indian dream (1%), Klamath rush lily (*Hastingia serpentinicola*) (1%), death camas (*Zigadenus micranthus*) (1%), falcate onion (*Allium falcifolium*) (1%), Tolmei's star tulip (2%), mountain trumpet (*Collinsia linearis*)(1%), Howell's lomatium (*Lomatium howellii*) (1%), bigseed biscuitroot (*Lomatium macrocarpum*) (1%), littleleaf miners lettuce (*Montia parviflora*) (1%), spreading phlox, and stonecrop (1%). The grass layer had the highest cover of any layer 21%, it was dominated by Idaho fescue (16%) and included sedge (*Carex concinnoides*) (4%), and lemon stipa (*Stipa lemmonii*) (3%).

Successional Trends

The Siskiyou Mat/Idaho Fescue//Serpentine Barrens type is found on convex shaped spur ridges where continued soil loss from sheet erosion prevents it from developing to a forest type. The presence of microhabitats small terraces indicates that areas with high Idaho fescue or Siskiyou mat cover are capturing fines washed off of the bare areas and beginning to develop a dark surface horizon with high organic matter. Due to the low vegetation cover and high amount of bare soil and rock it has a low potential for alteration from fire. However, low intensity fires in patches of high Idaho fescue cover will leave the surface bare of vegetation and lead to sheet erosion resetting the successional development clock back to zero.

Rare Plant Relationships

The Serpentine Barren/Siskiyou Mat/Idaho Fescue type contained 27 sensitive and rare plants, the highest number of all plant associations described in this field guide. This is probably due to the harsh nature of the environment in which these specialist plants have adapted. They included the sensitive plants Waldo rock-cress (*Arabis aculeolata*), Koehler's stipitate rock-cress, Macdonald's rock-cress, Preston Peak rock-cress (*Arabis serpentinicola*), yellow tubered toothwort (*Cardamine nuttallii* var. *gemmata*) Waldo buck-wheat, opposite-leaved lewisia, and pale yellow stonecrop. The rare plants found in this type included Siskiyou onion (*Allium siskiyouense*),evergreen everlasting, serpentine arnica, Klamath arnica (*Arnica spathulata*), short-lobed indian paintbrush (*Castilleja hispida* ssp. *brevilobata*) Siskiyou mountain willow herb (*Epilobium rigidum*), Waldo daisy (*Erigeron bloomeri* var. *nudatus*), ternate buckwheat (*Eriogonum ternatum*), Howell's horkelia, Del Norte County iris (*Iris innominata*), Howell's lomatium (*Lomatium howellii*) Howell's sandwort, timber bluegrass, Peck's sanicle (*Sanicula peckiana*) and Heckner's stonecrop.

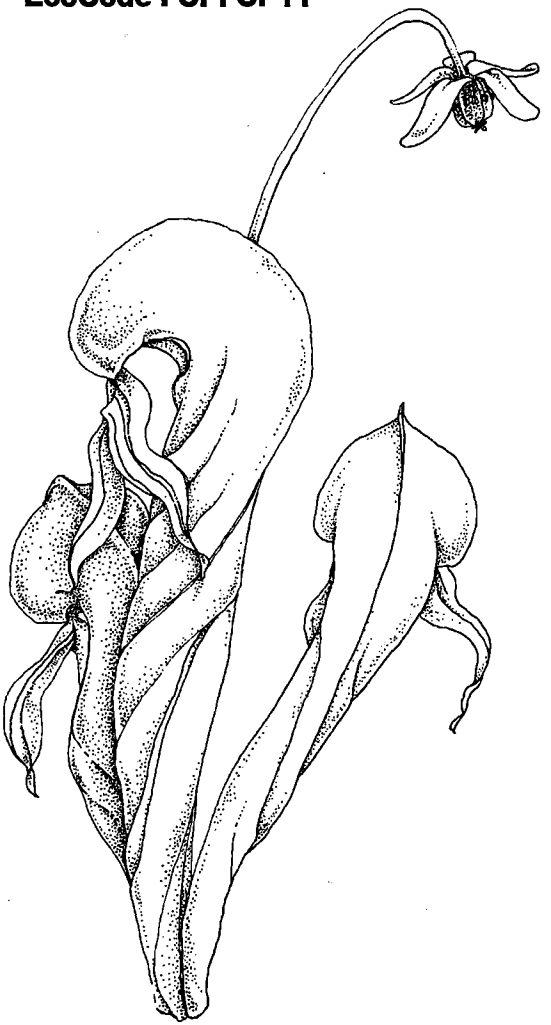
Management Implications

The Siskiyou Mat/Idaho Fescue//Serpentine Barrens type has low vegetation cover and high bare soil and surface rock. The ridge position and openness of this type encourages cross country travel which can contribute to resource damage. Due to the high frequency of sensitive and rare plants, and its susceptibility to surface erosion, management options are extremely limited.

Closely Related Types

The Siskiyou Mat/Idaho Fescue//Serpentine Barrens type is often found just upslope from the Jeffrey Pine/Idaho Fescue and Jeffrey Pine/Huckleberry Oak-Pinemat Manzanita/Idaho Fescue types. Site conditions in these two types are much better than the Siskiyou Mat/Idaho Fescue//Serpentine Barrens type as evidenced by their cover of tree, shrub, and grass vegetation.

California Pitcher Plant//Bog
DACA2//Bog Association
EcoCode FCPFCP11



Pitcher Plant
(Darlingtonia californica)

California Pitcher Plant//Bog
DACA2//Bog Association, EcoCode FCPFCP11

SUMMARY TABLE

(Sample Size:10)		COVER	CON
Tree Overstory Layer			
PIMO3	Western White Pine	4	100
CHLA	Port Orford Cedar	4	90
Tree Understory Layer			
CHLA	Port Orford Cedar	3	90
PIMO3	Western White Pine	2	90
Shrubs			
RHOC	Western Azalea	8	90
LEGL	Labrador Tea	5	80
RHCA2	Coffeeberry	1	60
LIDEE	Dwarf Tanbark Oak	2	60
Herbs & Grasses			
DACA2	Pitcher Plant	32	100
RUCAG	Cone-flower	2	90
NACA	Bog Asphodel	2	80
SCCR	Cottongrass	15	80
JUPH	Brownhead Rush	16	40

Environment

Elevation: 390-2700 ft.

Aspect: N.W.,S.W.

Slope: 5-85%

Slope Position: upper, middle, lower 1/3 &

intermittent draw

Surface Rock: 1-65%

SOILS

Pit Depth: 0-14"
Coarse Fragments: 8-35%
Textures: s, ls, gsl, & rock outcrops
Parent Material: Serpentine & Muck

Distribution/Environment

The California Pitcher Plant//Bog type was found on the Gasquet Ranger District, in cool, perennially wet, concave, lower and middle one-third slope positions. Elevation averaged 1681 feet and ranged from 390 to 2700 feet, lowest of all plant associations featured in this field guide. Slopes were moderately steep (33%), southwest facing which was moderated by topographic shading, and had low radiation index (.475).

Soil Summary

Soils in this type were derived from fine textured serpentine parent rocks which generally impart a basic pH. However, in this case due to the wet conditions and accumulation of organic matter tended to be moderately to strongly acidic. Surface pH averaged of 5.8 and sub-surface pH of 5.4. Soils were very poorly drained, shallow, loams and sandy loams, with low AWC (0.3") but high available water due to constant recharge, thick A horizons (7"), and very low A horizon coarse fragments (9%). They were found in the mesic soil temperature regime and were of very low productivity. The dominant soil family was mixed, mesic, Lithic Medifibrists.

Vegetation

Total vegetation cover was high and ranged from 78-99% with an average of 94%. Tree cover was low and included western white pine (4%), and Port Orford cedar (4%), with lodgepole pine (5%) and Jeffrey pine (1%) as occasional associates. The shrub layer was also of low cover (14%) as a result of moist, cool sites. It included western azalea (8%), Labrador tea (*Ledum glandulosum*) (5%), California coffeeberry (1%), and dwarf tanbark (2%). The forb layer had the highest cover of all layers 43%, along with a high diversity of plant species. It was dominated by California pitcher plant (*Darlingtonia californica*) (32%), with California cone-flower (2%), bog asphodel (*Narthecium californicum*) (2%), Bigelow's sneezeweed (*Helenium bigelovii*) (2%), western bog violet (*Viola primufolia* ssp. *occidentalis*) (3%), California lady's-slipper (*Cypripedium californicum*) (1%), and great burnet. The grass layer was also of high cover 26% and dominated by sedges and rushes. It often included cottongrass (*Scirpus criniger*) (15%), rush (*Juncus phaeocephalus*) (16%), fire reedgrass (*Calamagrostis koelerioides*) (2%), and a variety of other sedges (5%).

Successional Trends

The California Pitcher Plant//Bog type has low susceptibility to successional pathway alterations from fire due to its moist conditions. A more likely disturbance agent is alteration of water flow due to road building or mining exploration. This could lead to drying of the bogs and shifts in species composition towards upland plant associations. Port Orford cedar root disease could also affect this type by eliminating this species as a component.

Rare Plant Relationships

The California Pitcher Plant//Bog type contained seven sensitive and rare plants. These included the sensitive plants, Siskiyou indian paintbrush , great burnet, western bog violet, and the rare plants, California lady's-slipper, California pitcher plant, butterwort (*Pinguicula vulgaris* ssp. *macroceras*), and Del Norte willow (*Salix delnortensis*).

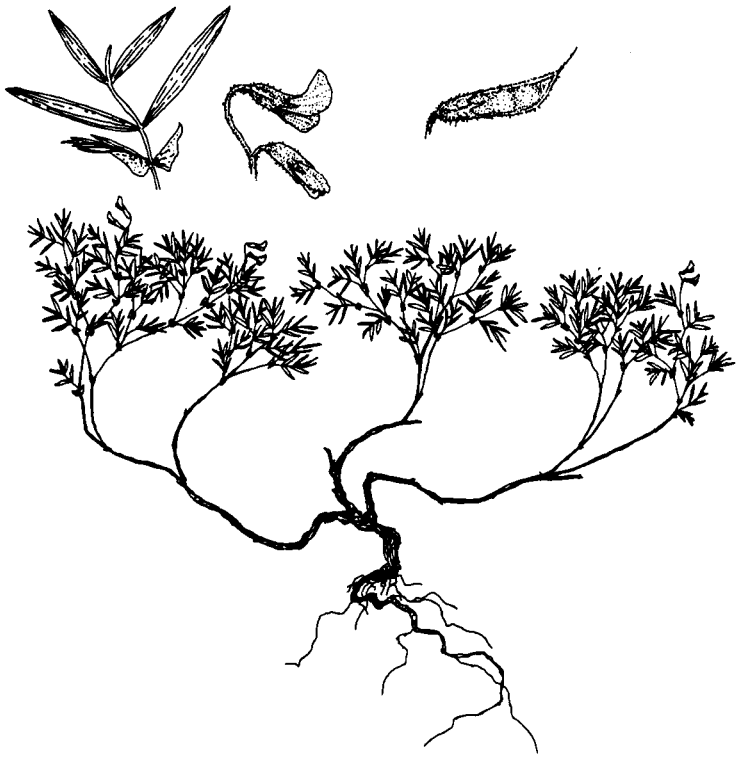
Management Implications

Alteration of water flow and introduction of Port Orford cedar root disease into this type are the main management concerns. Due to the high number of sensitive and rare plants any activity that could alter waterflow should be avoided. Furthermore existing or planned activities which increase the risk of introducing the root disease warrant reconsideration. Management within this type should be aimed at sensitive and rare plant species conservation.

Closely Related Types

The California Pitcher Plant//Bog type is often found just below the Port Orford cedar/Western Azalea type in streamside positions and is often intermixed with it.

Sensitive Plants



INTRODUCTION TO THE SENSITIVE PLANT SECTION

Evolution under the influence of the peculiarities of serpentine environments coupled with their insularity (existing as edaphic "islands") (Kruckeberg 1991) and limited distribution, give way to a floristic response rich in rare species. Given the propensity of these environments to support rare plants, this guide will not only describe the vegetation of serpentines but will compile information about featured plant species occurring in northwest California and southwest Oregon.

Species featured in this guide all occur in serpentine environments (not necessarily endemic) and are either members of the Six Rivers Sensitive Plant List or California Native Plant Society (CNPS) 1B species which are not yet included on the Forest list. National Forests maintain lists of species classified as "Sensitive". In Region 5 (California) of the Forest Service, Sensitive Plant Lists typically include any Federally-listed Threatened and Endangered Plant Species, state-listed species and CNPS List 1B species (plants considered rare, threatened or endangered in California and elsewhere) which occur or have the potential to occur on a respective Forest. Sensitive Plant Lists hold species that are considered the most vulnerable from a global and state-wide perspective in terms of threats, population size and distribution.

Rare serpentine plants other than those which are Forest Sensitive or CNPS 1B and which are documented on the Six Rivers are listed in a plant species/plant association matrix in the guide (Appendix VI). The Forest Sensitive Plant Lists of those Forests within the study area, namely, the Klamath and Shasta-Trinity National Forests in northwest California, and the Siskiyou National Forest in southwest Oregon, are also provided (Appendix VII).

For each featured species the following information will be provided:

Taxonomy

Both common and scientific names are provided according to the recently published Jepson Manual (Hickman 1993). Exceptions exist when a taxon was treated differently by CNPS ie. *Arabis serpentinicola* was combined with *A. macdonaldiana* in the Jepson Manual; the CNPS Inventory (Skinner and Pavlik 1994) maintains two distinct species. Exceptions are stated under "Notes" field. Family and common name are also presented.

Status

Rarity is relative--species considered rare in California may be more widespread in adjacent states. On the other hand, a species may only be known to occur in one very small area, in one specific habitat--this species gains relevance on a global scale. It is important to view rarity from various perspectives (weighing in genetic factors, inter-population differences or the global significance of a species under your wing); thus, the guide includes rankings for each species at a State, Federal and Global level. Species on a Forest's Sensitive Plant List are selected in part based upon the ranking assigned by various government agencies and professional societies operating at difference levels; specifically, State Natural Heritage Programs (in California, within the Department of Fish and Game), State Native Plant Societies and U.S. Fish and Wildlife Service, respectively. Rank and list assignments are defined in Appendix VIII.

Range

Most of the featured species in this guide occur solely in northwest California and southwest Oregon, in conjunction with the Josephine and Trinity ophiolite sheets. Species in CA and OR are listed by county. If a species occurs outside of CA or OR, only the state name will be listed. The map displayed for each species only shows the county distribution in CA. Range definitions represent the most current

information available on rare plant occurrences from databases managed by the Six Rivers, Klamath, Shasta Trinity and Siskiyou National Forests, California Natural Diversity Database (within the Heritage Program), Oregon Natural Heritage Program and CNPS.

Description
The body of text includes general morphological features that aid in plant identification; specifically, plant habit, leaves, flowers, fruit and any outstanding features. Photos of the plant and botanical illustrations support this text.

Habitat
This field provides a qualitative description of the physical and biological characteristics of the habitat which are easily recognized. Typical characteristics include: parent material, slope position, topography, elevation, moisture conditions and any micro-habitat features that exist. Photos of the plant habitat (when availiable) support the text. Quantitative information and common associating species can be obtained from the corresponding plant association/special habitat descriptions provided in the first half of the guide.

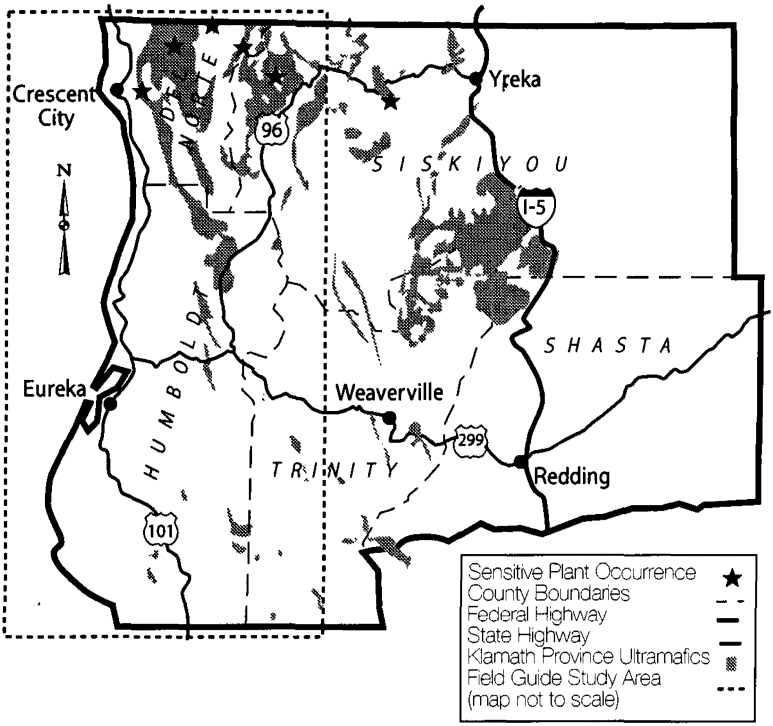
Plant Association/Special Habitat
Lists the associations or special habitats in which the species was found. The page number for specific plant associations or special habitat descriptions is provided.

Notes
Elaboration about taxonomic questions, taxonomic changes, "look-alike" taxa and distribution is provided under this header.

Arabis aculeolata **E. Greene**

Waldo rock cress

Family: Brassicaceae



Status

CNPS List: 1B
CNPS R-E-D CODE: 3-2-1
State: - -
St. Rank: S2
Federal: Category 3c
Global Rank: G4

Range

California
- Del Norte Co.
- Siskiyou Co.

Oregon-southwest
- Curry Co.
- Douglas Co.
- Jackson Co.
- Josephine Co.

Waldo rock cress
(Arabis aculeolata)

Description

Habit: Perennial herb, 2-3.5 dm, caudex branched, stems with hairs.

Leaves: Basal rosette, entire to wavy, ciliate, obovate, 1-4 cm.

Flowers: Petals purple. Blooms April - June.

Fruit: Silique erect to ascending, 3.5-6.5 cm. Seeds winged.

Habitat

Occurs on dry, gravelly to bouldery, steep, semi-stabilized slopes of serpentine or peridotite origin, often on ridges. Extremely open setting or barren with very low vegetation cover. Plants often found growing in rock crevices. Elevation 900-1800m (2975-5950 ft.).

Plant Association/Special Habitat Relationship

Siskiyou Mat/Idaho Fescue//Serpentine Barren (p.G-3)

Jeffrey Pine/Huckleberry Oak-Pinemat Manzanita/Idaho Fescue (p.B-11)

Jeffrey Pine-Douglas-fir/Huckleberry Oak/California Fescue (p.B-15)

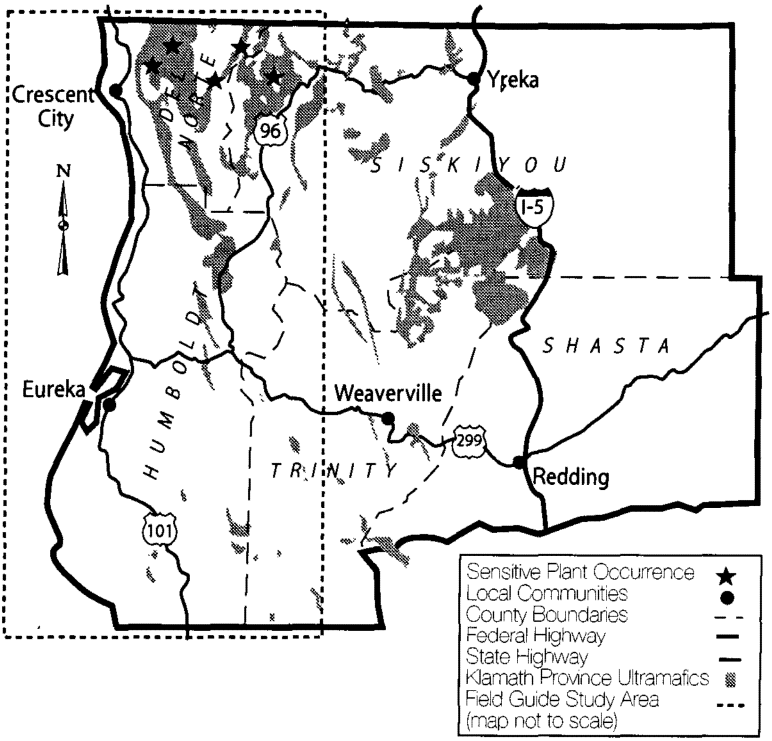
Notes

A. aculeolata similar in appearance to *A. macdonaldiana* which also occurs in Del Norte Co.; *A. aculeolata* displays hairs on the stem and leaf surface, *A. macdonaldiana* is generally glabrous. Habitat characteristics between both species are very similar. *A. aculeolata* difficult to locate when not in bloom. Taxonomic revision pending (Vorobik 1993).

Arabis koehleri Howell var. ***stipitata*** Roll.

Koehler's stipitate rock cress

Family: Brassicaceae



Status

CNPS List: 1B
CNPS R-E-D Code: 3-1-2
State: - -
State Ranking: S1
Federal: Category 3c
Global Ranking: G3T3

Range

California
- Del Norte Co.
- Siskiyou Co.

Oregon-southwest
- Curry Co.
- Jackson Co.
- Josephine Co.

Koehler's stipitate rock cress
(Arabis koehleri var. *stipitata)*

Description

Habit: Perennial herb, 5-30 cm, caudex woody, stems generally glabrous.

Leaves: Basal many, hairs present, linear to oblanceolate, 1-2 cm.

Flowers: Petals scarlet to purple. Blooms June-July.

Fruit: Silique ascending to spreading, 5-8 cm. Seeds winged.

Habitat

Occurs on dry (occasionally mesic), rocky, moderate to steep slopes or ridges of serpentine, peridotite or occasionally of dioritic or metasedimentary origin. Present on outcrops. Often found on rocky micro-sites within Jeffrey pine-dominated plant association. Elevation 500-1800m (1650-5950 ft.).

Plant Association/Special Habitat Relationship

Siskiyou Mat/Idaho Fescue//Serpentine Barren (p.G-3)

Jeffrey Pine/Huckleberry Oak-Pinemat Manzanita/Idaho Fescue (p.B-11)

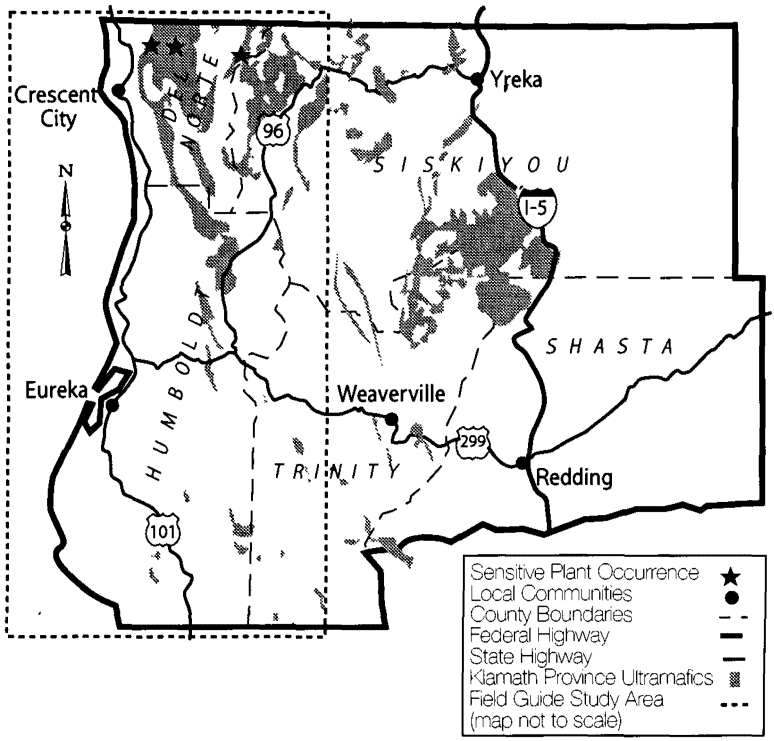
Notes

A. koehleri var. *stipitata* similar in appearance to *A. breweri.*

Arabis macdonaldiana Eastw.

McDonald's rock cress

Family: Brassicaceae



Status

CNPS List: 1B

CNPS R-E-D Code: 2-3-2

State: ---

State Ranking: S2

Federal: Category 2

Global Ranking: --

Range

California

Del Norte Co.

Mendocino Co.[1]

Oregon-southwest

Curry Co.

McDonald's rock cress
(Arabis macdonaldiana)

Description

Habit:: Perennial herb, 1-3 dm., caudex branched, stems glabrous.

Leaves: Basal rosette, toothed margins, glabrous or bristle-tipped, obovate, 1-2 cm.

Flowers: Petals pink to purple. Blooms April-June.

Fruit: Silique erect to ascending, 2.5-3.5 cm. Seeds wingless.

Habitat

Occurs on dry gravelly to bouldery, moderate to steep, semi-stabilized slopes of serpentine or peridotite origin, typically on ridges. Typically found in extremely open setting or barren. Often found on rocky micro-sites in Jeffrey pine-dominated woodland. Plants often found growing in rock crevices. Elevation 1200-1500m. (3950-5000 ft.).

Plant Association/Special Habitat Relationship

Siskiyou Mat/Idaho Fescue//Serpentine Barren (p.G-3)

Jeffrey Pine-Huckleberry Oak-Pinemat Manzanita/Idaho Fescue (p.B-11)

Jeffrey Pine/Idaho Fescue (p.B-7)

Notes

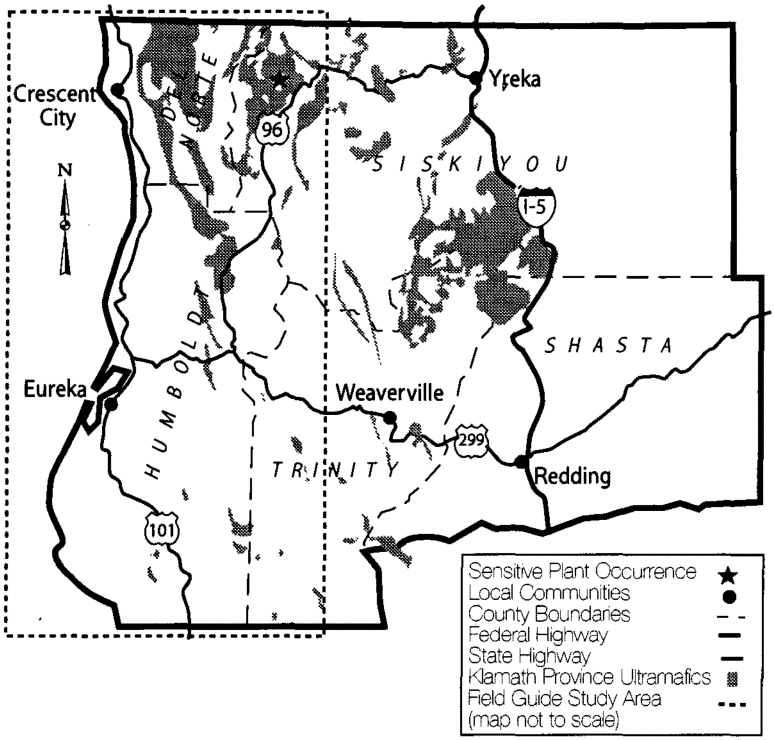
A. macdonaldiana is similar in appearance to *A. aculeolata* and *A. serpentinicola. A. aculeolata* can be distinguished by the hairs on its stem and leaves. *A. macdonaldiana* and *A. serpentinicola* are generally glabrous throughout but can be distinguished by their respective habitats, the latter occurring above 1800m. (5900 ft.). *A. macdonaldiana* very difficult to locate when not in bloom. Most occurrences on the Six Rivers National Forest are within the North Fork Smith Botanical Area.

[1] Taxonomic revision pending which may combine the Del Norte Co. population with the Mendocino Co. population (Vorobik 1993).

Arabis serpentinicola Rollins

Preston Peak rock cress

Family: Brassicaceae

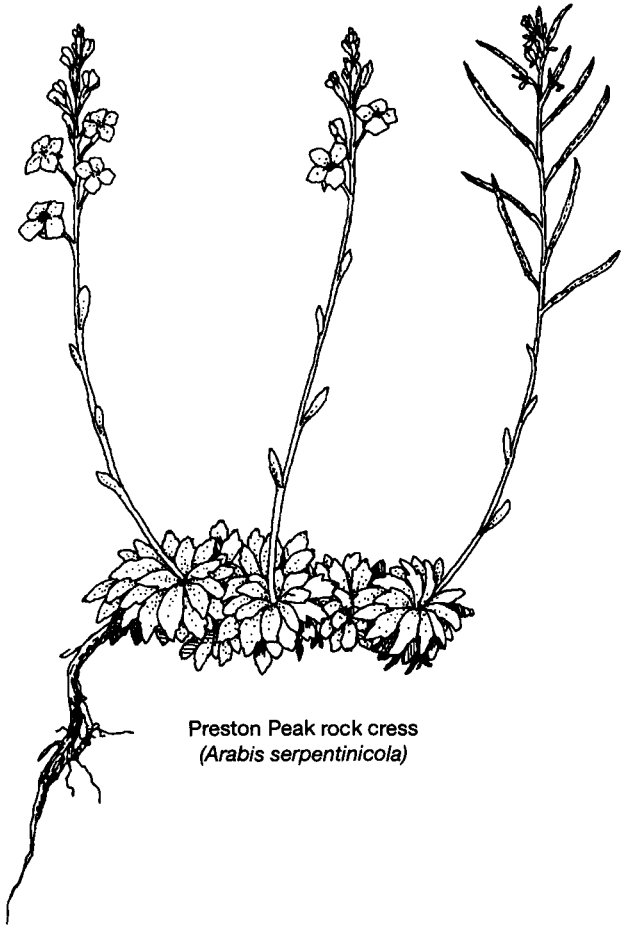


Status

CNPS List: 1B
CNPS R-E-D Code: 3-1-3
State: - -
State Ranking: S1.2
Federal: Category 2
Global Ranking: G1Q

Range

California
Del Norte Co.
Siskiyou Co.
Oregon-southwest
Curry Co.



Preston Peak rock cress
(Arabis serpentinicola)

Description

Habit: Perennial herb,1.5-3 dm, branched caudex, glabrous throughout..

Leaves: Basal rosette, dentate margins, obovate, 1.5-2.5 cm.

Flower: Petals pink to purple. Blooms June-July.

Fruit: Silique, 2.0-3.5 cm. Seeds wingless.

Habitat

Occurs on high elevation, dry, gravelly to bouldery ridgetops and steep, northerly-facing slopes of primarily serpentine or peridotite but also gabbro origin. Open setting. Elevation >1800m (> 5950 ft.).

Plant Association/Special Habitat

Serpentine Barren (p.G-1)

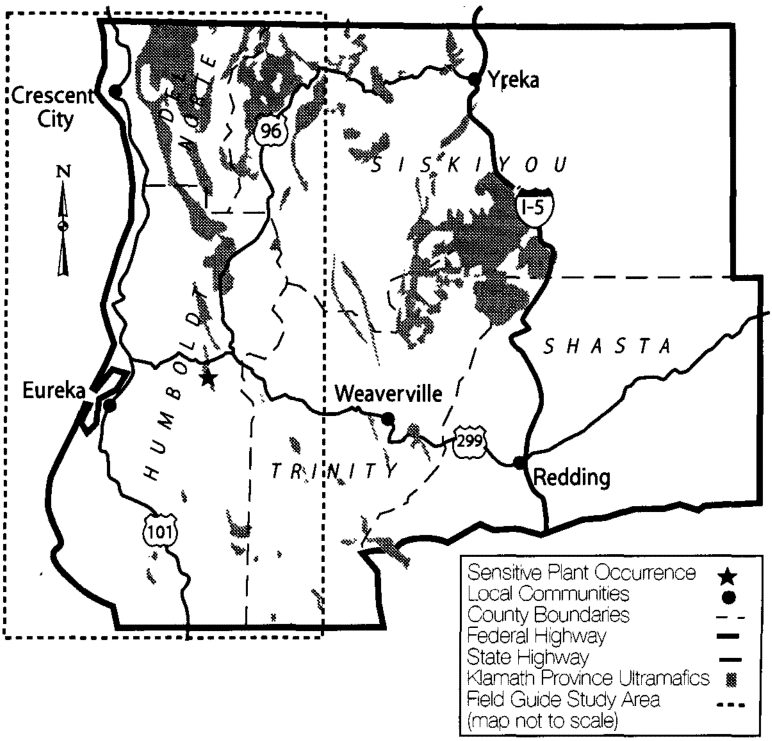
Notes

A. serpentinicola is similar in appearance to *A. macdonaldiana*; but can be distinguished by habitat; the former occurring above 1800m (5900 ft.). The Jepson Manual (1993) combines these two taxa under *A. macdonaldiana*.

Arctostaphylos canescens Eastw. *ssp. sonomensis* (Eastw.) Wells

Sonoma manzanita

Family: Ericaceae



Status

CNPS List: 1B

CNPS R-E-D Code: 2-2-3

State: - -

State Ranking: - -

Federal: - -

Global Ranking: G3T2

Range

California

Humboldt Co.

Lake Co.

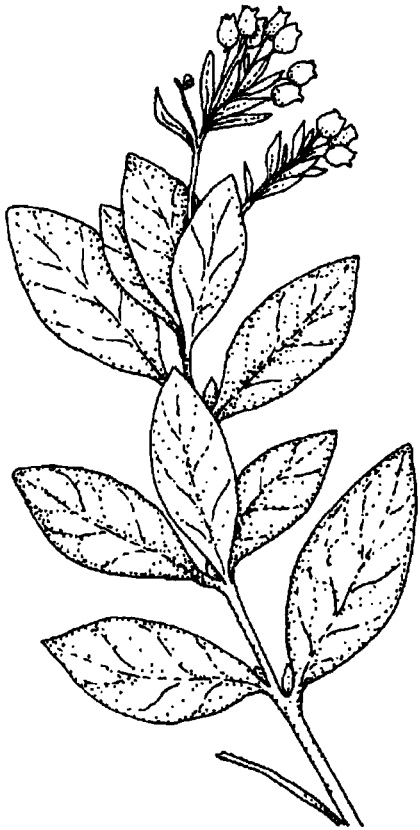
Mendocino Co.

Sonoma Co.

Tehama Co.

Oregon-southwest

None



Sonoma manzanita
(Arctostaphylos canescens ssp. *sonomensis)*

Description

Habit: Shrub 0.3-2.0m, burl absent, stem twigs finely glandular.

Leaves: Erect, entire margin, ovate to elliptic, surfaces glaucous becoming strigose, 2-5 cm.

Flower: Inflorescence with glandular pedicel. Petals white to pink. Blooms May-June.

Fruit: Berry 5-10 mm.

Habitat

Occurs on dry, rocky ridges and slopes of serpentine origin (in southern portion of its range, occurs on volcanics). Chaparral dominated vegetation with open overstory. Elevation 200-1500m (656-4920 ft.).

Plant Association/Special Habitat

Jeffrey Pine-Incense Cedar/Huckleberry Oak/Beargrass (p.B-35)

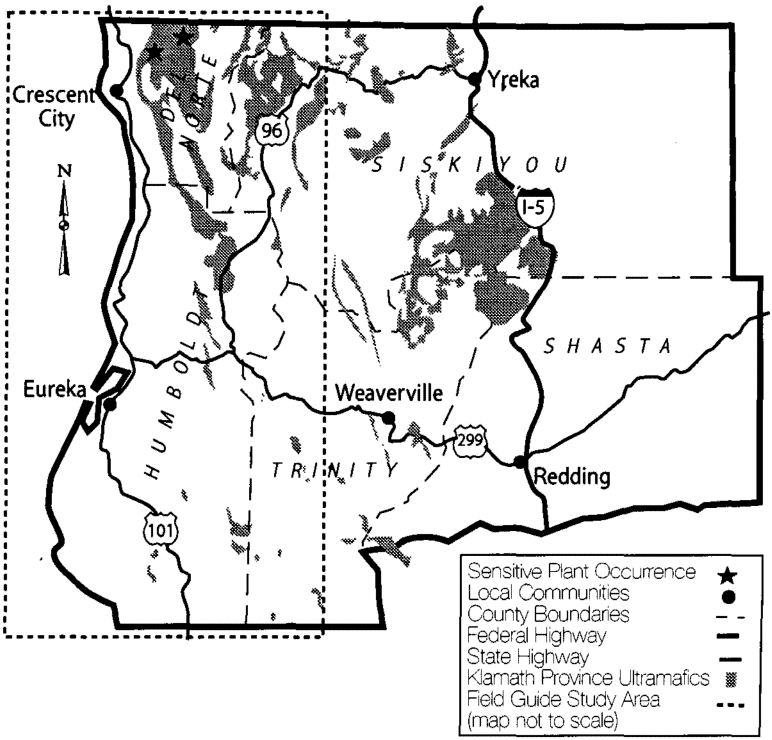
Notes

Recommend for addition to the Forest Sensitive Plant List.

Cardamine nuttallii E.Greene var. ***gemmata*** E.Greene

yellow tubered toothwort

Family: Brassicaceae



Status

CNPS List: 1B

CNPS R-E-D Code: 3-1-2

State: - -

State Ranking: S2

Federal: Category 2

Global Ranking: G5T3

Range

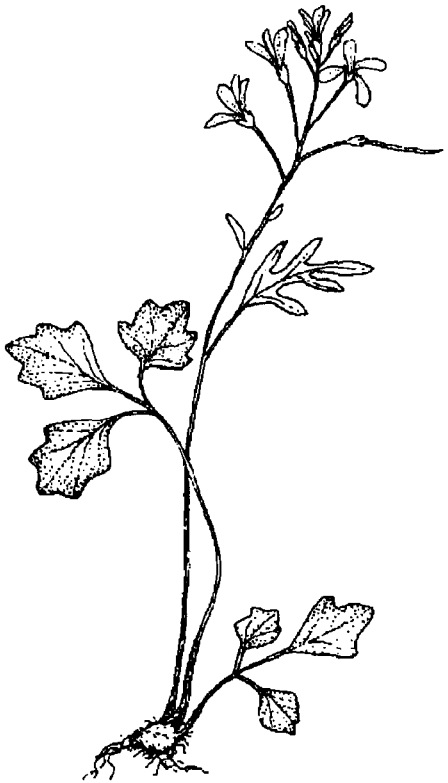
California

Del Norte Co.

Oregon-southwest

Curry Co.

Josephine Co.



yellow tubered toothwort
(Cardamine nuttalliii var. *gemmata)*

Description

Habit: Perennial herb, <2 dm, rhizomed (yellow), glabrous throughout.

Leaves: Rhizome leaflets 3-5, subpalmately arranged, toothed, ovate to elliptic; cauline leaflets 3-5, entire, linear, 1-4 cm.

Flower: Petals pale pink to purple, rarely white. Blooms April-June.

Fruit: Silique, 2-5 cm.

Habitat

Occurs on bare to bouldery, moderate to steep, semi-stable slopes of serpentine, peridotite or metasedimentary origin. Plants found growing among boulders. Elevation 150-1100m. (450-3300 ft.).

Plant Association/Special Habitat

Jeffrey Pine/Idaho Fescue (p.B-7)

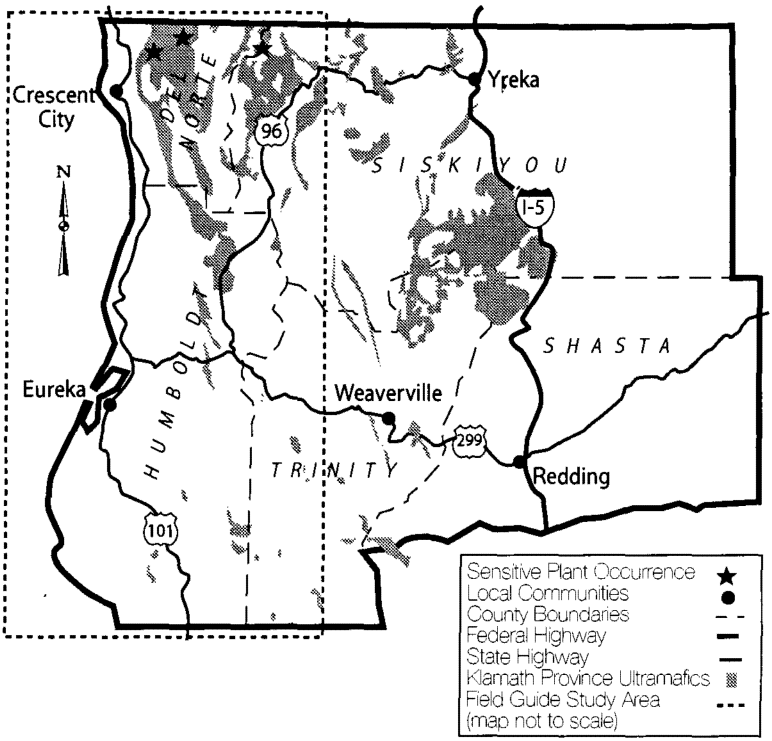
Jeffrey Pine/Huckleberry Oak-Pinemat Manzanita/Idaho Fescue (p.B-11)

Siskiyou Mat/Idaho Fescue//Serpentine Barren (p.G-3)

Notes

C. nuttallii var. *gemmata* is similar in appearance to other varieties of *C. nuttallii* (esp. var. *dissecta*). *C. nuttallii* var. *gemmata* is recommended for addition to the Forest Sensitive Plant List. Most occurrences on the Six Rivers National Forest are within the North Fork Smith Botanical Area.

Castilleja miniata Hook ssp. ***elata*** (Piper) Munz
Siskiyou indian paintbrush
Family: Scrophulariaceae



Status

CNPS List: 2
CNPS R-E-D Code: 1-2-1
State: - -
State Ranking: S?
Federal: Category 3c
Global Ranking: G5T3

Range

California
Del Norte Co.
Siskiyou Co.[1]
Oregon-southwest
Curry Co.
Josephine Co.

Siskiyou paintbrush
(Castilleja miniata ssp. *elata)*

Description

Habit: Perennial herb, 40-80 cm, few-branched, slender, glabrous to hairy above.

Leaves: Entire margins, lanceolate, 30-60 mm.

Flower: Petals pink to yellow-orange. Blooms June-August.

Fruit: Capsule 6-10mm.

Habitat

Occurs in bogs, seeps, meadows and on streambanks of serpentine or peridotite origin. Found in moist to wet micro-sites surrounded by Port Orford cedar and within Jeffrey pine or western white pine stands. Ground cover moderate to high. Elevation < 1400m (< 4600 ft.).

Plant Assocation/Special Habitat

California Pitcher Plant Bog (p.G-7)

Port Orford Cedar/Western Azalea (p.D-11)

Port Orford Cedar-Western White Pine/Huckleberry Oak (p.D-23)

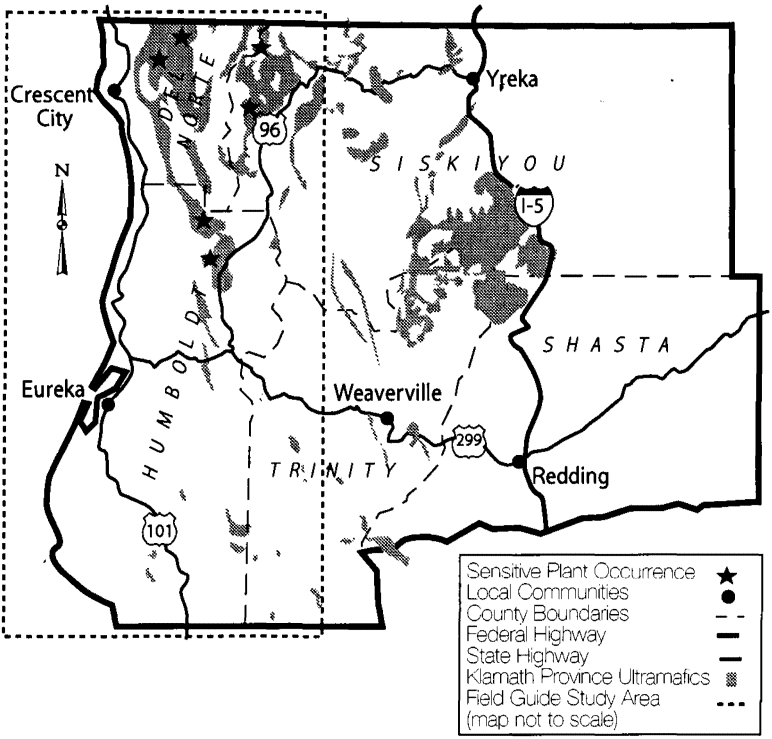
Notes

C. miniata ssp. *elata* similar in appearance to *C. miniata* ssp. *miniata*; the former distinguished from *C. miniata* ssp. *miniata* by its habit which is more slender, its smaller flowers and its presence in serpentine habitats. In Del Norte County, often found along with other featured plants, specifically *Gentiana setigera, Sanguisorba officinalis* and *Viola primulifolia* ssp. *occidentalis.* Most occurrences on the Six Rivers National Forest are within the North Fork Smith Botanical Area.

Dicentra formosa (Haw.) Walp. ssp. ***oregana*** (Eastw.) Munz

Oregon bleeding heart

Family: Papavaraceae



Status

CNPS List: 4

CNPS R-E-D Code: 1-2-2

State: - -

State Ranking: S?

Federal: Category 3c

Global Ranking: G5T4

Range

California

Del Norte Co.

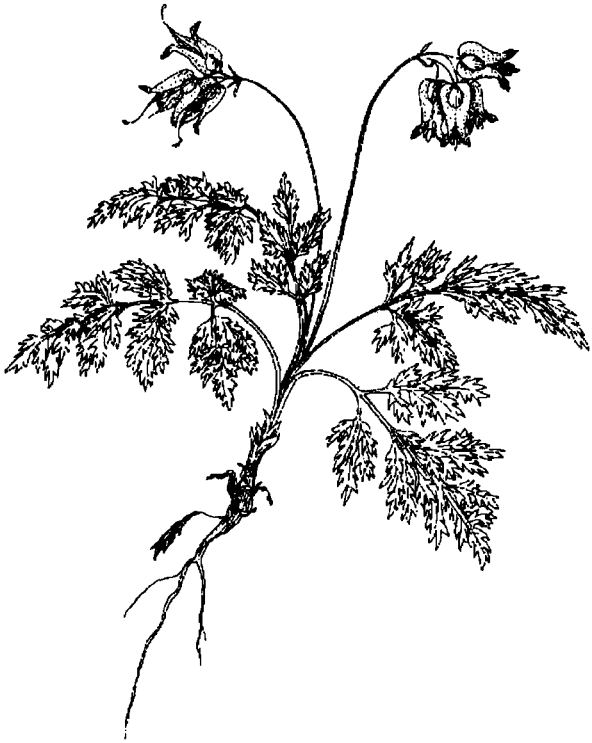
Humboldt Co.

Siskiyou Co.

Oregon-southwest

Curry Co.

Josephine Co.



Oregon bleeding heart
(Dicentra formosa ssp. *oregana)*

Description

Habit: Perennial herb, 20-45 cm, rhizomed.

Leaves: Biternately compound, dissected, bluish, glaucous, 20-50 cm.

Flower: Petals, outer creme and inner rose-tipped, flower pendent, 3.5-5.5 mm. Blooms May-June.

Fruit: Capsule, 14-20 mm.

Habitat

Occurs on dry, cobbly to bouldery, moderate slopes or ridges of serpentine or peridotite origin. Open setting but can occupy rocky micro-sites within forested types with dense shrub cover. Can occupy disturbed sites such as road banks or old road beds. Elevation 600-1600m (1975-5300 ft.).

Plant Association/Special Habitat

Western White Pine-Lodgepole Pine/Huckleberry Oak-Rhododendron (p.F-13)

Western White Pine-Douglas-fir/Huckleberry Oak-Dwarf Tanbark (p. F-9)

Western White Pine-Sugar Pine/Huckleberry Oak-Dwarf Tanbark (p.F-5)

Jeffrey Pine/Idaho Fescue (p.B-7)

Douglas-fir/Huckleberry Oak (p.C-21)

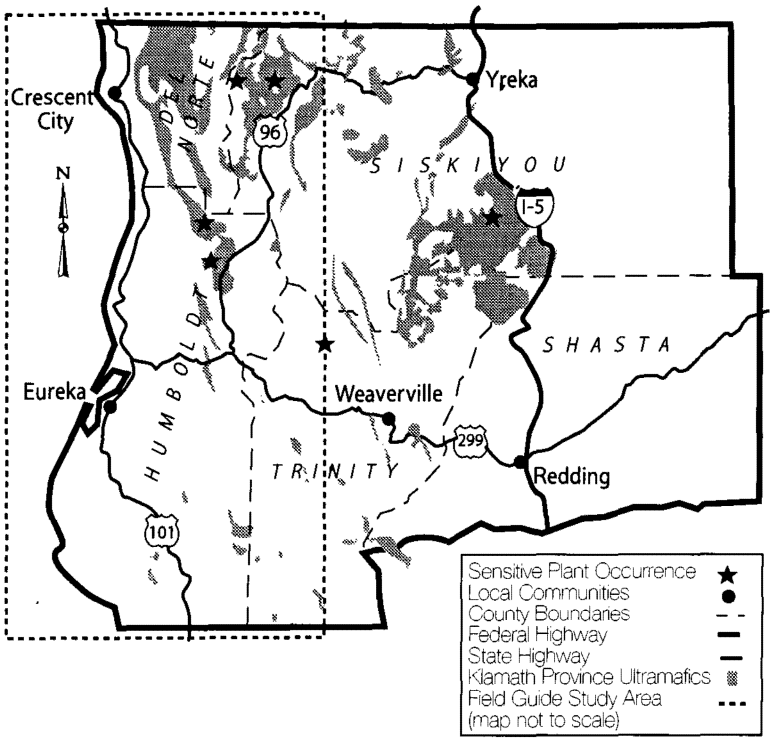
Notes

Jepson (1993) does not recognize the ssp. *oregana*; but combines this with sub-species *Dicentra formosa*. Taxomony applied here in accordance with Munz (1973).

Draba carnosula O.E. Schulz

Mt. Eddy draba

Family: Brassicaceae



Status

CNPS List: 1B
CNPS R-E-D Code: 3-1-3
State: - -
State Ranking: S2
Federal: Category 2
Global Ranking: G2

Range

California
Del Norte Co.
Siskiyou Co.
Trinity Co.
Oregon-southwest
None.

Mt. Eddy draba
(Draba carnosula)

Description

Habit: Perennial herb, <12 cm, stems 1-few from base, glabrous.

Leaves: Basal rosette, entire margin, glabrous on surface, obovate, 4-8 mm.

Flower: Petals yellow. Blooms July-August.

Fruit: Silique glabrous, 12-22 mm. Seeds winged.

Habitat

Occurs on high elevation rocky slopes, ridgetops, cliff faces of serpentine or granodiorite origin. Open setting, found growing in crevices of rock. Upper montane and sub-alpine forest. Elevation 2000-3000m (6600-9900 ft.).

Plant Association/Special Habitat

N/A

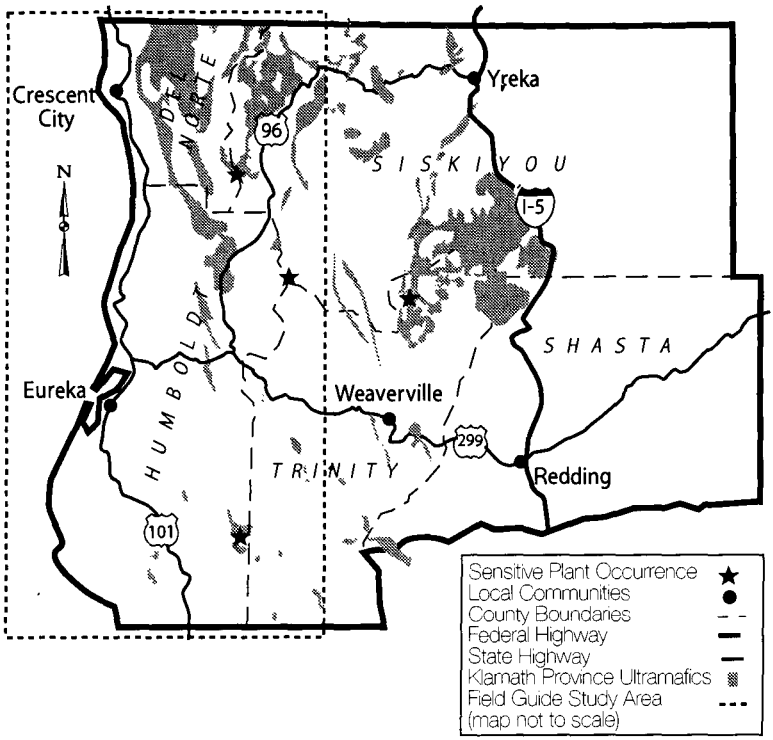
Notes

N/A

Epilobium oreganum E.Greene

Oregon fireweed

Family: Onagraceae



Status

CNPS List: 1B

CNPS R-E-D Code: 2-2-2

State: - -

State Ranking: S1

Federal: Category 2

Global Ranking: G2

Range

California[1]

Humboldt Co.

Siskiyou Co.

Trinity Co.

Oregon-southwest[1]

Josephine Co.

Oregon fireweed
(Epilobium oreganum)

Description

Habit: Perennial herb, 4-10 dm, glabrous, glaucous.

Leaves: Veins reddish, lanceolate to narrowly ovate, 30-90 mm.

Flower: Petals pink to rose-purple. Blooms June-August.

Fruit: Capsule, hairy and glandular, 25-45 mm.

Habitat

Occurs in continuously wet, gently sloping meadows, bogs, and stream banks of most typically serpentine or peridotite origin but also of non-serpentine origin. Occasionally occurs in channels or ditches. Open to semi-shaded setting. Elevation 500-1600m (1640-5300 ft.).

Plant Association/Special Habitat

N/A

Notes

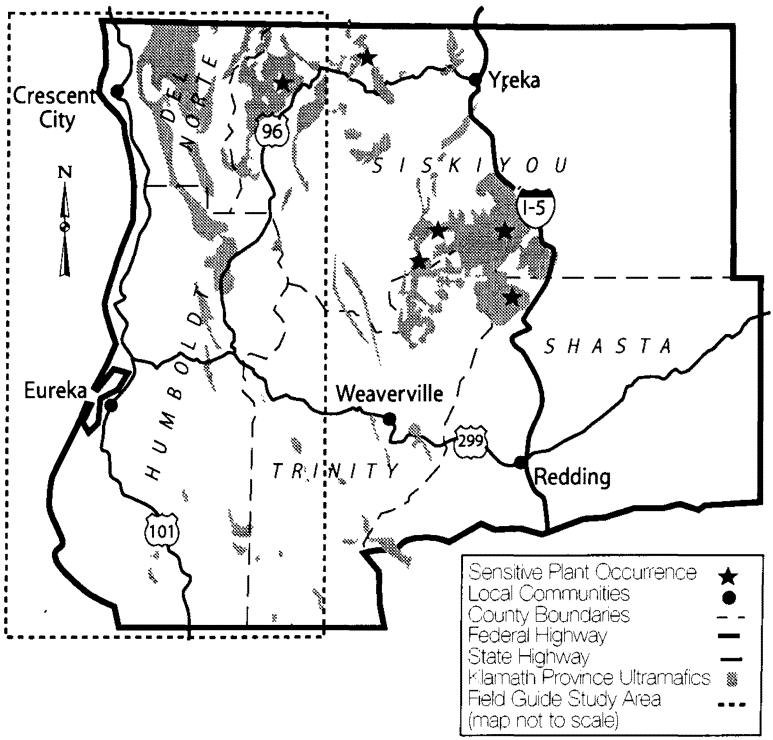
Distinguishing characteristic of *E. oreganum* is the 4-lobed stigma. Other similar appearing taxa of *Epilobium* club-shaped stigma.

[1] CNPS Inventory (1994) also notes occurrences in Mendocino, Shasta, Tehama and Eldorado Counties. According to J. Kagan (1995) occurrences of *E.oreganum* from counties other than Trinity Co. are historic locations. Distribution in California needs further study.

Epilobium siskiyouense (Munz) Hoch & Raven

Siskiyou fireweed

Family: Onagraceae



Status

CNPS List: 1B

CNPS R-E-D Code: 3-1-2

State: - -

State Ranking: S2

Federal: Category 3c

Global Ranking: G3

Range

California

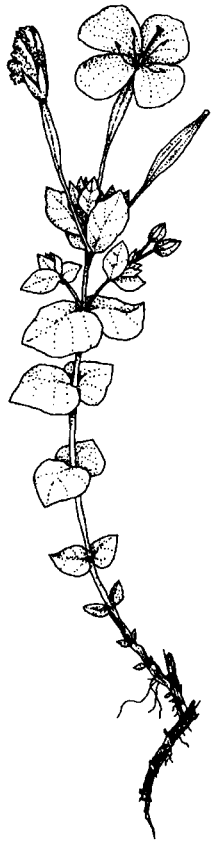
Siskiyou Co.

Trinity Co.

Oregon-southwest

Siskiyou Co.

Josephine Co.



Siskiyou fireweed
(Epilobium siskiyouense)

Description

Habit: Perennial sub-shrub, 1-2.5 dm, clumped, scaly shoots from woody caudex, glandular, glabrous to strigose.

Leaves: Sessile, sparcely strigose, widely lanceloate to ovate, 13-26 mm.

Flowers: Petals pink to rose-purple. Blooms July-September.

Fruit: Capsule, hairy, 25-45 mm.

Habitat

Occurs on dry, gravelly to rocky, ridgetops and scree slopes of serpentine origin. High elevation, associated with Jeffrey pine, western white pine, foxtail pine, mountain hemlock and Shasta red fir. Elevation 1300-2700m (4300-8900 ft.).

Plant Association/Special Habitat

N/A

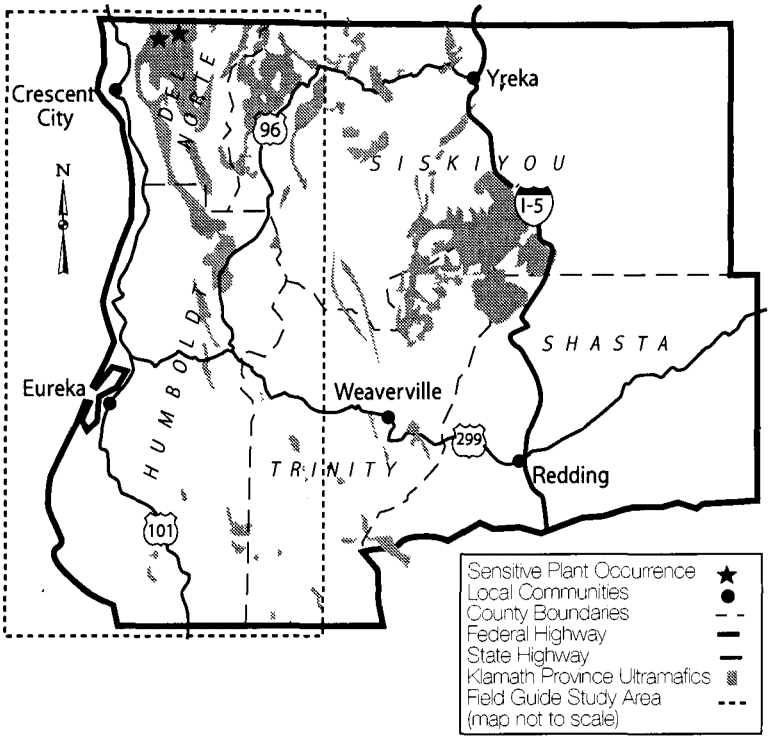
Notes

Not known to occur on Six Rivers National Forest.

Eriogonum pendulum Wats.

Waldo buckwheat

Family: Polygonaceae



Status

CNPS List: 2

CNPS R-E-D Code: 3-2-1

State: None

State Ranking: S2

Federal: Category 3c

Global Ranking: G4

Range

California

Del Norte Co.

Oregon-southwest

Curry Co.

Josephine Co.

Waldo buckwheat
(Erigonum pendulum)

Description

Habit: Perennial, sub-shrub, 20-50 cm.

Leaves: Cauline, clustered near stem tips, white-woolly, oblanceolate, 15-50 mm.

Flowers: Bell-shaped bract, calyx white with hairs. Blooms August-September.

Fruit: Capsule, hairy, 3-5 mm.

Habitat

Occurs on dry, gravelly to cobbly, gentle to moderate slopes or ridges of serpentine or peridotite origin. Can occupy rocky micro-sites within open forest types. Observed on disturbed sites (road banks) and proximal to areas disturbed by mining. Elevation 400-1000m (1300-3300 ft.).

Plant Association/Special Habitat

Jeffrey Pine/Idaho Fescue (p.B-7)

Jeffrey Pine/Huckleberry Oak-Pinemat Manzanita/Idaho Fescue (p.B-11)

Western White Pine-Sugar Pine/Huckleberry Oak-Dwarf Tanbark(p.F-5)

Western White Pine-Douglas-fir/Huckleberry Oak-Dwarf Tanbark(p.F-9)

Siskiyou Mat/Idaho Fescue//Serpentine Barren (p.G-3)

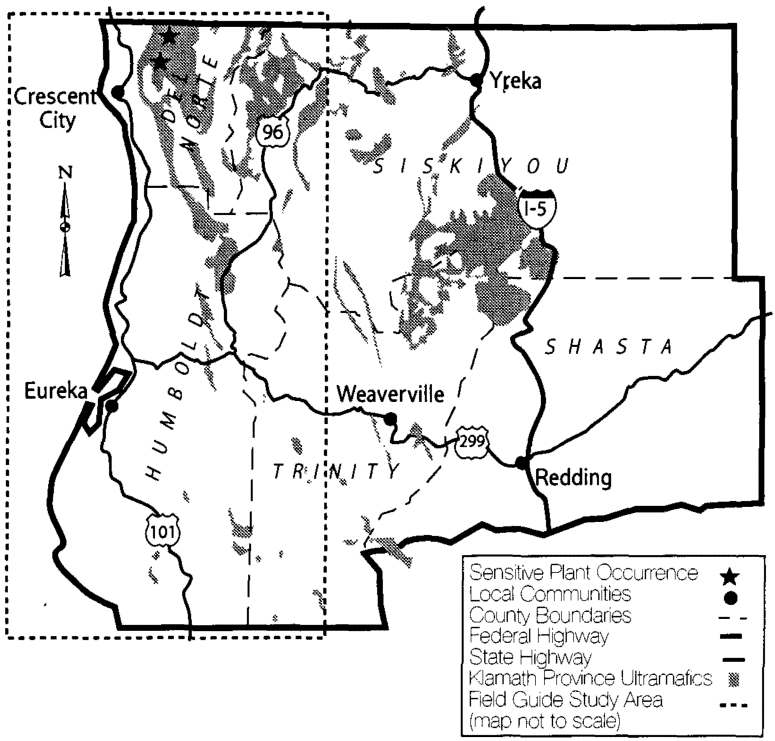
Notes

Most occurrences on the Six Rivers National Forest are within the North Fork Smith Botanical Area.

Gentiana setigera A. gray

Mendocino gentian

Family: Gentianaceae



Status

CNPS List: 1B
CNPS R-E-D Code: 3-3-2
State: - -
State Ranking: S1
Federal: Category 2
Global Ranking: G3

Range

California
Del Norte Co.
Mendocino Co.
Oregon-southwest
Curry Co.
Josephine Co.

Mendocino gentian
(Gentiana setigera)

Description

Habit: Perennial herb, 20-45 cm.

Leaves: Basal, obovate, 25-85 mm long, 5-15 mm wide; cauline leaves many.

Flower: Petals blue. Blooms July-September.

Fruit: Achene, winged.

Habitat

Occurs in mesic to wet meadows, streamsides and bogs on benches on benches of serpentine or peridotite origin. Open to partially shaded setting. Observed in wet micro-sites surrounded by Port Orford cedar and within Jeffrey pine or western white pine stands. Elevation + 1065m (+3500 ft.).

Plant Association/Special Habitat

California Pitcher Plant Bog (p.G-7)

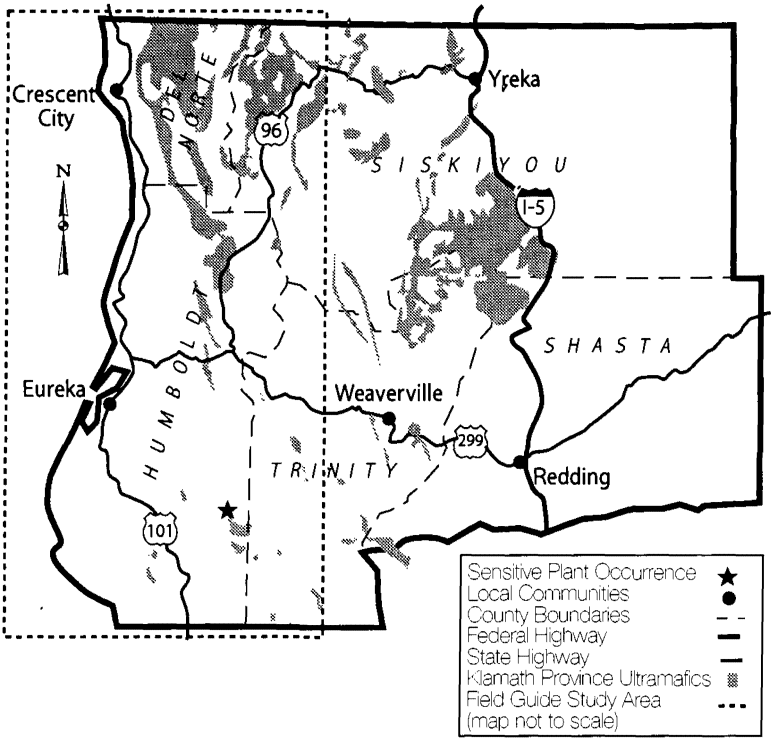
Notes

In Del Norte County, often found along with other featured plants, specifically *Castilleja miniata* ssp. *elata, Viola primulifolia* ssp. *occidentalis* and *Sanguisorba officinalis*. Recommended for addition to the Forest service Sensitive Plant list. Most occurrences on the Six Rivers National Forest are within the North Fork Smith Botanical Area and the L.E. Horton RNA.

Lathyrus biflorus T.W. Nelson & J.P. Nelson

two-flowered pea

Family: Fabaceae



Status

CNPS List: 1B

CNPS R-E-D Code: 3-1-3

State Ranking: S1

State: - -

Federal: Category 1

Global Ranking: G1

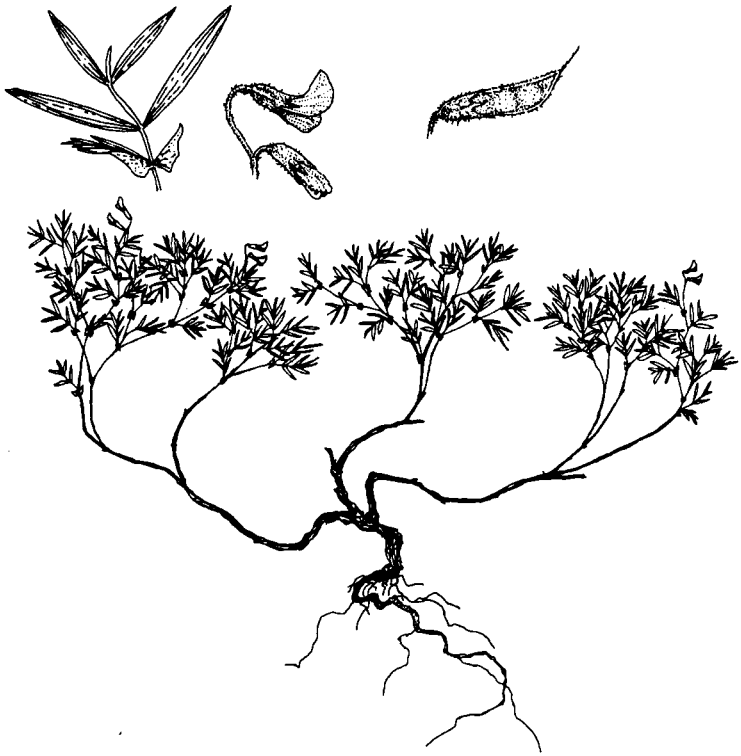
Range

California

Humboldt Co.

Oregon-southwest

None



two-flowered pea
(Lathyrus biflorus)

Description

Habit: Perennial herb, 3-5 cm, rhizomed, stems erect to decumbent, puberulent.

Leaves: Leaflets oblong to lanceolate, 0.5-1.0 cm; tendril bristle-like.

Flower: Petals greenish white, dark-striate. Blooms May-July.

Fruit: Capsule, glabrous, 13-15 mm.

Habitat

Occurs on moderate slopes of serpentine origin. Open setting in surrounding forest type dominated by Jeffrey pine. Elevation + 1300m.

Plant Association/Special Habitat

Serpentine Barren (p.G-1)

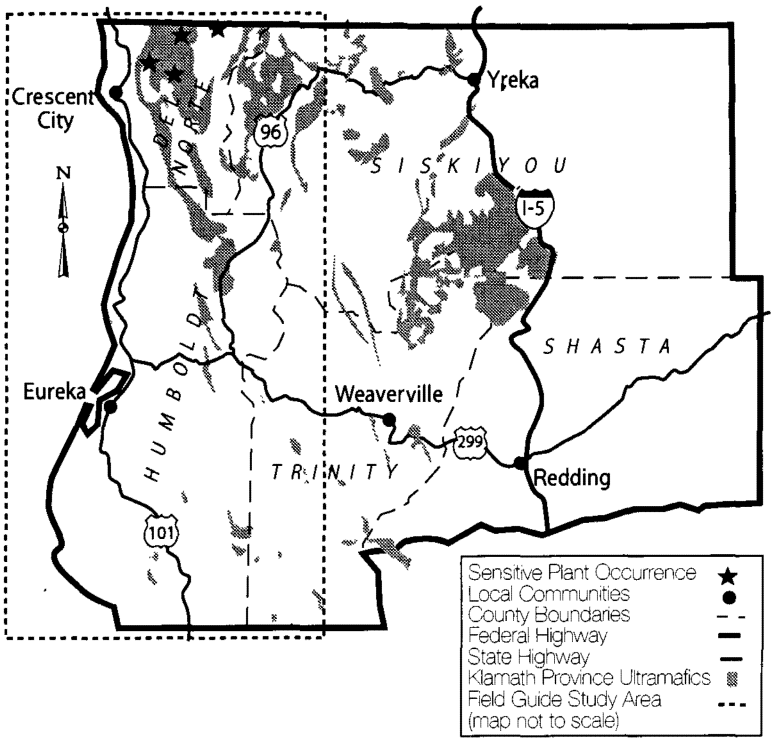
Notes

L. biflorus is not known to occur on Six Rivers National Forest. Occurs on private land with limited restricted access immediately adjacent to the National Forest; therefore little is known about its habitat and ecology.

Lewisia oppositifolia (S. Watson) Robinson

opposite-leaved lewisia

Family: Portulacaceae



Status

CNPS List: 1B

CNPS R-E-D Code: 2-2-2

State Ranking:S?

State: - -

Federal: Category 3c

Global Ranking: G3

Range

California

Del Norte Co.

Oregon-southwest

Curry Co.

Jackson Co.

Josephine Co.

opposite-leaved lewisia
(Lewisa oppositifolia)

Description

Habit: Perennial herb, 4-14 cm, root and caudex fusiform.

Leaves: Loose rosette, entire, narrowly linear-oblanceolate, 5-11 cm.

Flower: Petals white or pink. Blooms March-June.

Fruit: Capsule 5-6mm..

Habitat

Occurs on mesic, gravelly to cobbly plateau settings of serpentine or peridotite origin. Also occupies open micro-sites within Jeffrey pine stands. Elevation 300-1200m (1000-4000 ft.).

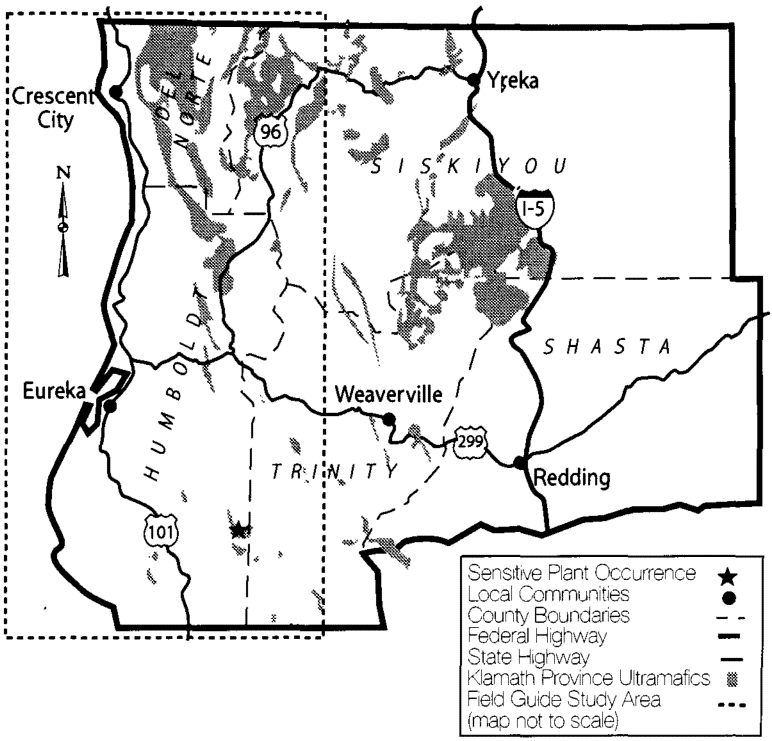
Plant Association/Special Habitat

Siskiyou Mat/Idaho Fescue//Serpentine Barren (p.G-3)

Notes

Given *L. oppositifolia's* occurrence in settings of flat topography, populations are particularly vulnerable to cross-country travel. Certain occurrence areas contained fire rings, fragments of clay pigeons (related to recreational shooting), trash piles and mining-related scars. Most occurrences on the Six Rivers National Forest are within the North Fork Smith Botanical Area.

Lupinus constancei T.W. Nelson & J.P. Nelson
the Lassics lupine
Family: Fabaceae



STATUS

CNPS List: 1B
CNPS R-E-D Code: 3-2-3
State Ranking: S1
State: - -
Federal: Category 2
Global Ranking: G1

Range

California
Humboldt Co.
Oregon-southwest
None

the Lassics lupine
(Lupinus constancei)

Description

Habit: Perennial herb, <1.5 dm, matted, shaggy-hairy.

Leaves: Cauline, clustered near base; leaflets 6-7, 10-20mm.

Flower: Petals pink to burgundy. Blooms June-July.

Fruit: Capsule, shaggy, 1.5-2.5 cm.

Habitat

Occurs on high elevation, dry, gravelly to cobbly, moderate to steep, semi-stabilized slopes of serpentine origin. Extremely open setting or barren. Elevation 1500-2000m (4950-6600 ft.).

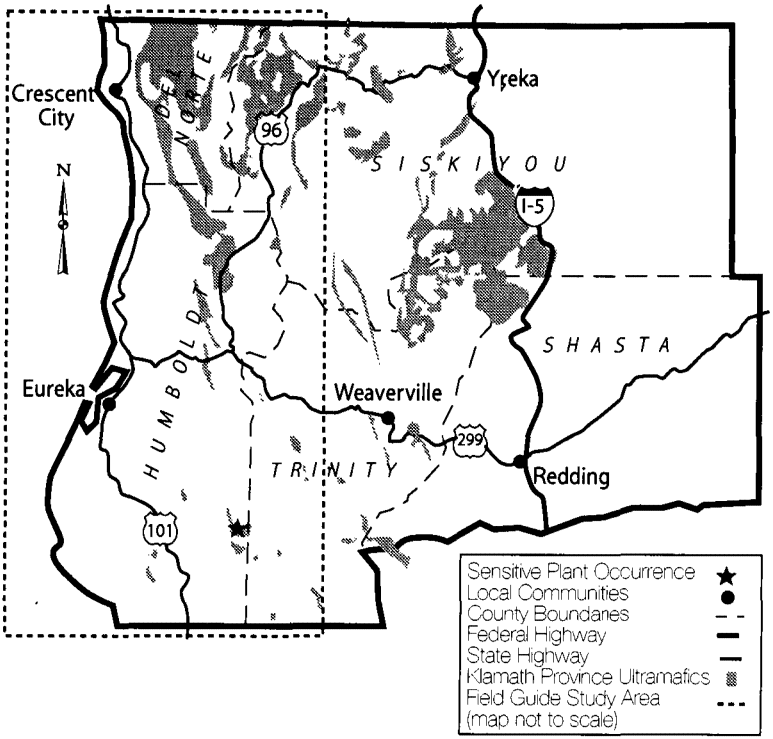
Plant Association/Special Habitat

Serpentine Barren (p.G-1)

Notes

Endemic to the Lassics region (specifically within the Lassics Botanical Area). Documented occurrences are very localized covering less than 2 acres.

Minuartia decumbens T.W. Nelson & J.P. Nelson
the Lassics sandwort
Family: Caryophyllaceae



STATUS

CNPS List: 1B
CNPS R-E-D Code: 3-2-3
State Ranking: S
State: None
Federal: Category 2
Global Ranking: G1

Range

California
- Humboldt Co.
- Shasta Co.
- Tehama Co.
- Trinity Co.

Oregon-southwest
- None

the Lassics sandwort
(Minuartia decumbens)

Description

Habit: Perennial herb, 4-15 cm, decumbent, tap-root, glabrous.

Leaves: Ascending, rigid, evenly spaced, needle-like to awl-shaped, 3-6 mm.

Flower: Petals white. Blooms June-July.

Fruit: Capsule 1.8-2.2 mm.

Habitat

Occurs on dry, gravelly, gentle to moderate slopes of serpentine origin. Open to partially shaded setting. Elevation 1500-1800m (4950-6600 ft.).

Plant Association/Special Habitat

Jeffrey Pine-Incense Cedar/Siskiyou Mat (p.B-31)

Serpentine Barren (p.G-1)

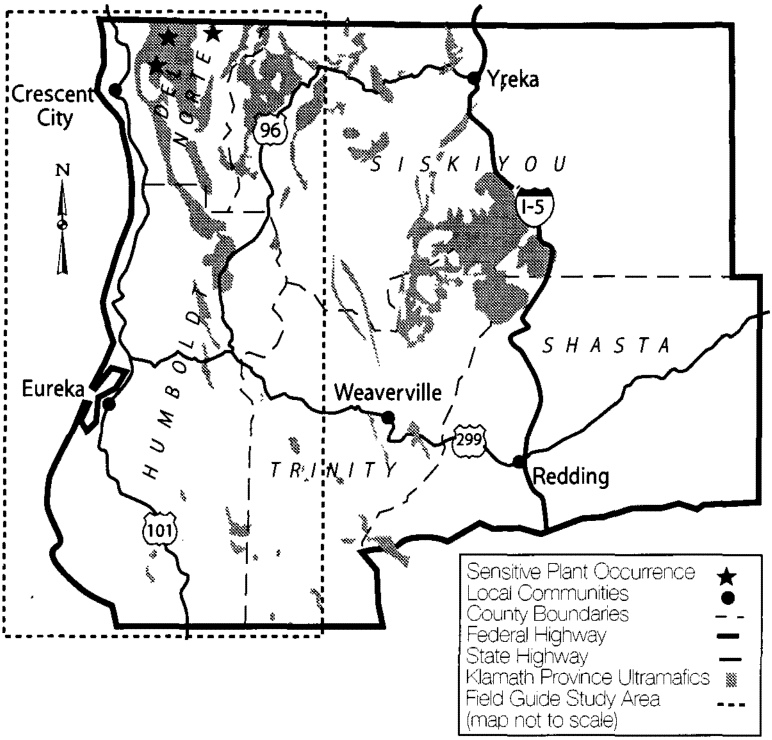
Notes

M. decumbens is similar in appearance to *M. nuttallii* which also occupies the same habitat. *M. decumbens* can be distinguished from *M. nuttallii* by its glabrous stems and leaves, the latter is glandular-hairy. On the Six Rivers, occurrences are almost entirely within the Lassics Botanical Area.

Sanguisorba officianalis **L.**

great burnet

Family: Rosaceae



Status

CNPS List: 2

CNPS R-E-D Code: 2-2-1

State: - -

State Ranking: S2

Federal: - -

Global Ranking: G5?

Range

California

Del Norte Co.

Humboldt Co.

Mendocino Co.

Oregon to British Columbia

great burnet
(Sanguisorba officianalis)

Description

Habit: Perennial herb, 50-140 cm, rhizomed, erect.

Leaves: Basal present at flowering, largest 20-40 cm; leaflets 3-6 per side, largest 25-30 mm, teeth > 15, ovate-oblong.

Flower: Sepals dark purplish. Blooms July-September

Fruit: Achene, 2.5-3.5 mm.

Habitat

Occurs in mesic to wet meadows and bogs often of serpentine or peridotite origin. Open to partially shaded setting, observed in microsites surrounded by Port Orford cedar and within Jeffrey pine stands. Elevation 120-1400m (400-4600 ft.).

Plant Association/Special Habitat

Port Orford Cedar/Western Azalea (p. D-11)

California Pitcher Plant Bog (p. G-7)

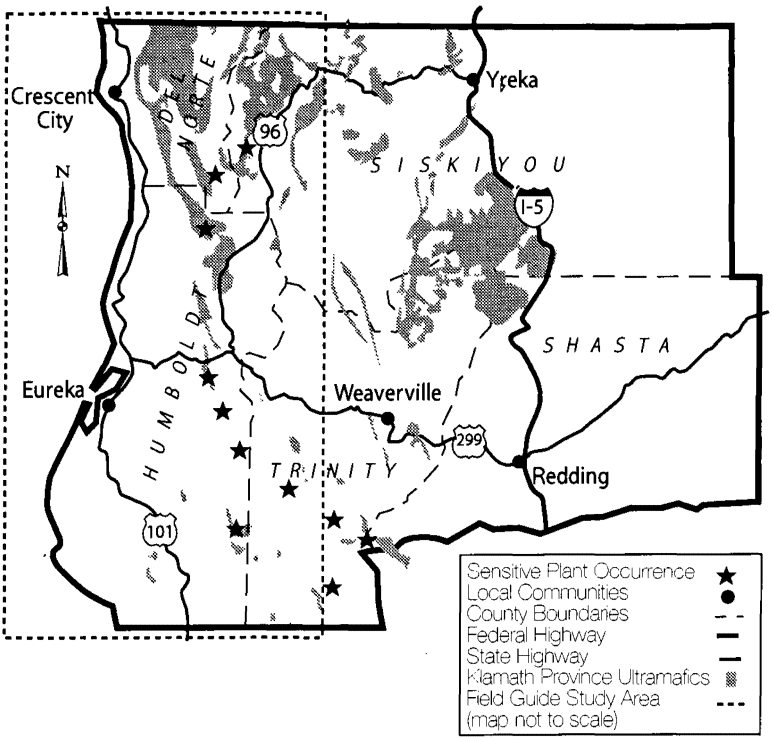
Notes

In Del Norte County, often found along with other featured plants, specifically *Gentiana setigera, Castilleja miniata* ssp. *elata* and *Viola primulifolia* ssp. *occidentalis*. Recommended for addition to the Forest Sensitive Plant List.

Sedum laxum (Britton) A.Berger ssp. ***flavidum*** Denton

pale yellow stonecrop

Family: Crassulaceae



Status

CNPS List: 4

CNPS R-E-D Code: 1-1-3

State: - -

State Ranking: S3

Federal: Category 3c

Global Ranking: G5?T3

Range

California

Del Norte Co.

Glenn Co.

Humboldt Co.

Shasta Co.

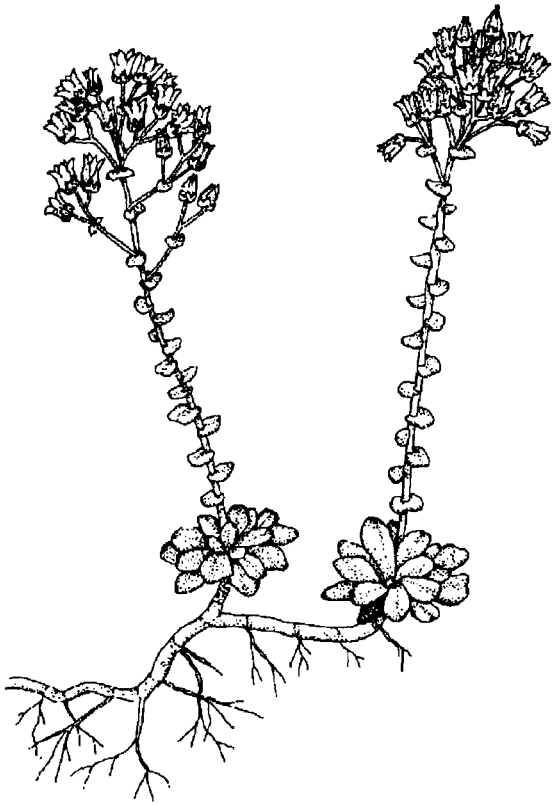
Siskiyou Co.

Tehama Co.

Trinity Co.

Oregon-southwest

None



pale yellow stonecrop
(Sedum laxum ssp. *flavidum)*

Description

Habit: Plant 9-24 cm, rosettes 1-6 cm diameter, sometimes glaucous.

Leaves: Rosette leaves 9-25 mm; , obovate; cauline base truncate and ear-like.

Flower: Petals pale yellow. Blooms June.

Fruit: Follicle, 6-12mm.

Habitat

Occurs on dry, cobbly to bouldery ridgetops, slopes and cliff faces of serpentine, metabasaltic and sandstone origin. Often found growing in crevices of outcrops. Observed on rocky micro-sites within forested stands. Typically, extremely open setting. Elevation 800-2000m (2650-6600 ft.).

Plant Association/Special Habitat

Jeffrey Pine/Idaho Fescue (p.B-7)

Jeffrey Pine/Huckleberry Oak-Pinemat Manzanita/Idaho Fescue (p.B-11)

Jeffrey Pine-Incense Cedar/Huckleberry Oak/Beargrass (p.B-35)

Siskiyou Mat/Idaho Fescue//Serpentine Barren (p.G-3)

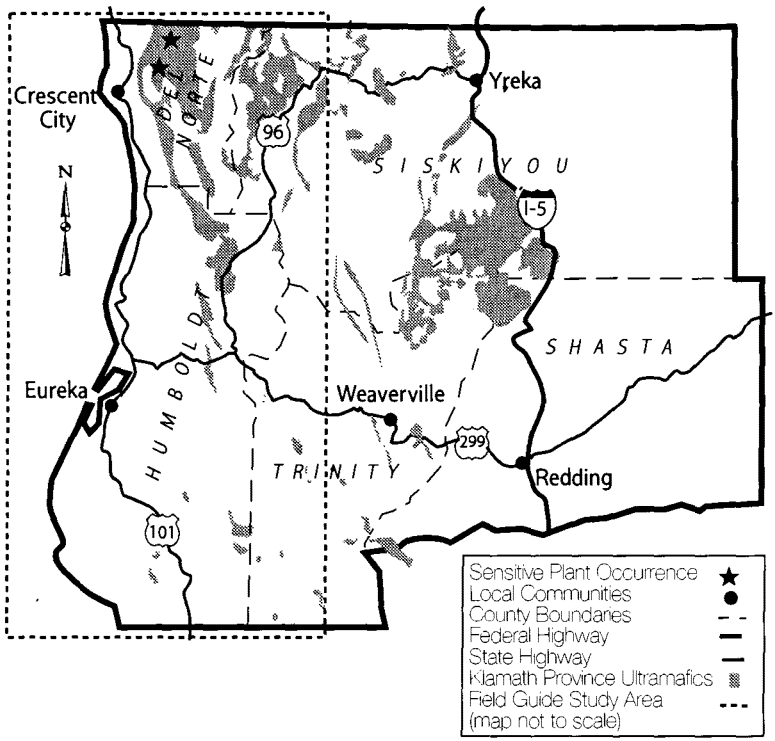
Notes

Taxonomically difficult. When not in bloom similar in appearance to other species of *Sedum* spp.

Streptanthus howellii S. Watson

Howell's jewelflower

Family: Brassicaceae

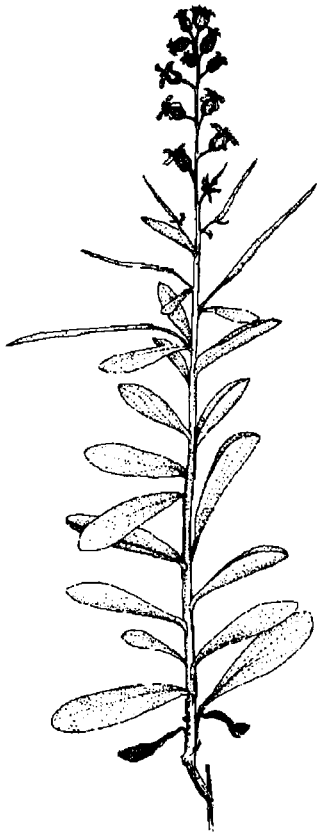


Status

CNPS List: 1B
CNPS R-E-D Code: 3-2-2
State: - -
State Ranking: S1
Federal:Category 3c
Global Ranking: G4

Range

California
Del Norte Co.
Oregon-southwest
Curry Co.
Josephine Co.



Howell's jewelflower
(Streptanthus howellii)

Description

Habit: Perennial herb, 3-7 dm.

Leaves: Basal 2-10 cm, entire to coarsely dentate, fleshy, obovate; cauline petioled to near sessile, narrowly obovate.

Flower: Petals maroon. Blooms June-August.

Fruit: Silique ascending to spreading, curved, 5-9 cm.

Habitat

Occurs on dry, cobbly to bouldery slopes and ridges of peridotite or serpentine origin. Open to partially shaded setting. Often observed on disturbed sites such as (road banks or road beds). Elevation 600-1500m (2000-4950 ft.).

Plant Association/Special Habitat

Jeffrey Pine/Huckleberry Oak-Pinemat Manzanita/Idaho Fescue (p.B-11)

Western White Pine-Lodgepole Pine/Dwarf Tanbark-Pacific rhododendron (p.F-13)

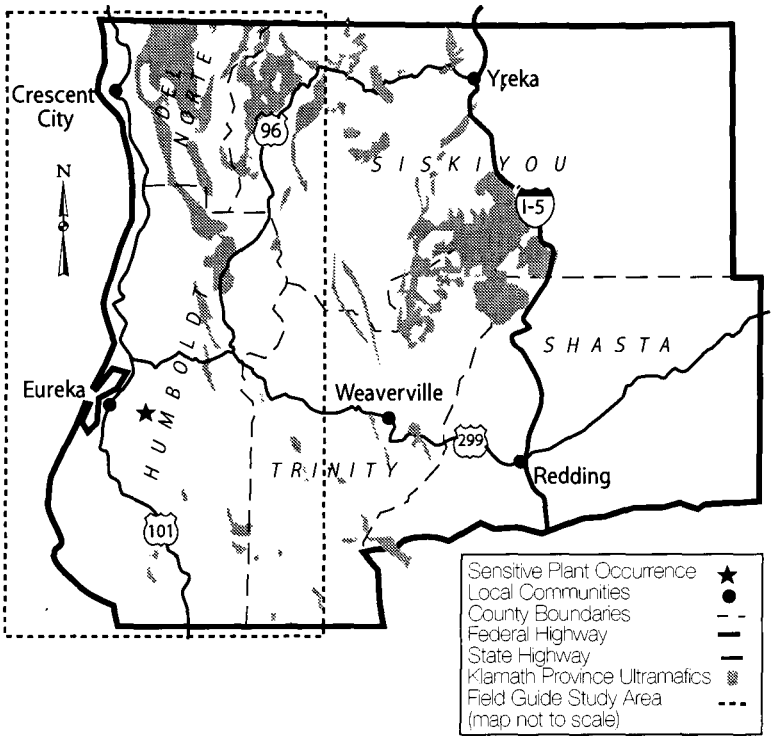
Notes

Most occurrences on the Six Rivers National Forest are within the North Fork Smith Botanical Area.

Thlaspi californicum S.Watson

Kneeland Prairie penny-cress

Family: Brassicaceae



Status

CNPS List: 1B

CNPS R-E-D Code: 3-3-3

State: - -

State Ranking:S1

Federal: Category 1

Global Ranking: G1

Range

California

Humboldt Co.

Oregon-southwest

None.

Kneeland Prairie penny-cress
(Thlaspi californicum)

Description

Habit: Perennial herb, 1-20 cm, caudex branched.

Leaves: Basal rosette, sparcely dentate, 2-4 cm; cauline sessile, entire to dentate, 1-1.5 cm.

Flower: Petals white. Blooms May-June.

Fruit: Silique, 7-10 mm.

Habitat

Occurs on outcrops of peridotite origin. Soils are shallow and well-drained. Typically found distributed among variously-sized boulders. Open setting. Observed growing in one case on a disturbed site (road fill-slope). Elevation 500-700m (1650-2300 ft.).

Plant Association/Special Habitat

N/A

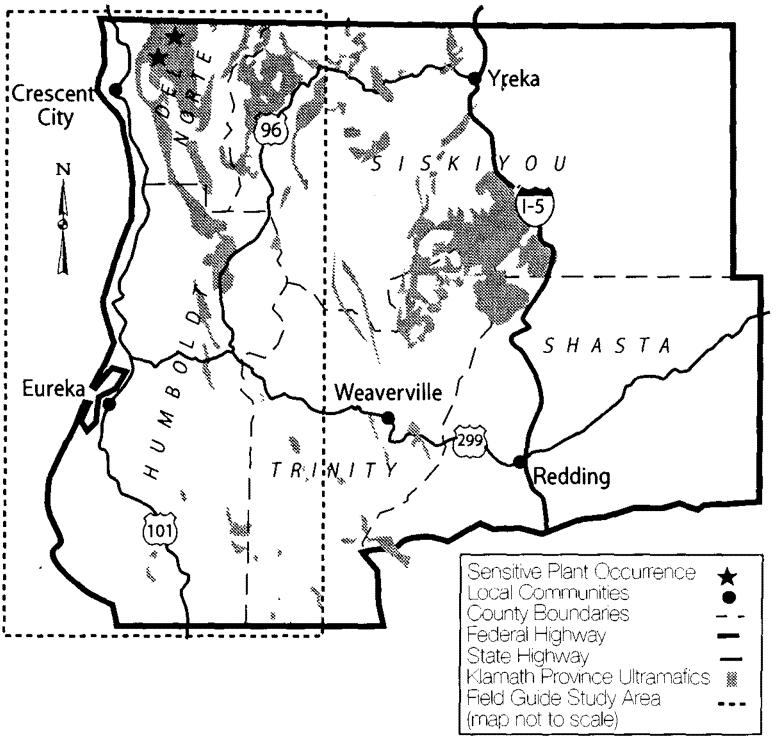
Notes

Not known to occur on Six Rivers National Forest. Population is on private land and very localized.

***Viola primulifolia* L. ssp. *occidentalis* (A. Gray) L.E. McKinney & R.J. Little**

western bog violet

Family: Violaceae



Status

CNPS List: 1B

CNPS R-E-D Code: 2-2-2

State: - -

State Ranking: S2?

Federal: Category 2

Global Ranking:G4T2

Range

California

Del Norte Co.

Oregon

Curry Co.

Josephine Co.

western bog violet
(Viola primulifolia ssp. occidentalis)

Description

Habit: Perennial herb, 8-19 cm, rhizomed, glabrous.

Leaves: Basal, crenate, elliptic to widely ovate, 15-70 mm; petiole 30-110 mm.

Flower: Petals white, lowest 3 veined purple. Blooms April-August.

Fruit: Capsule, glabrous, 5-8 mm.

Habitat

Occurs in wet seeps (a few associated with road cuts), along streamsides and most typically in bogs on benches of serpentine or peridotite origin. Open to partially shaded setting. Often found growing from between rocks. Observed in wet micro-sites surrounded by Port Orford, Jeffrey pine, Douglas-fir, lodgepole pine or western white pine stands. Elevation 100-700m (330-2300 ft.).

Plant Association/Special Habitat

California Pitcher Plant Bog (p.G-7)

Notes

In Del Norte County, often found along with other featured plants, specifically *Castilleja miniata* ssp. *elata*, *Gentiana setigera* and *Sanguisorba officinalis*. When not in flower has been misidentified as *Parnassia californica*. Most occurrences on the Six Rivers National Forest are within the North Fork Smith Botanical Area.

Appendices

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APPENDIX I: PLANT SPECIES LIST

Plant Species List

Tree Species

Species	Common Name	EDP
Abies concolor	white fir	ABCO
Abies magnifica var.*shastensis*	red fir	ABMAS
Acer macrophyllum	bigleaf maple	ACMA
Alnus rhombifolia	white alder	ALRH
Alnus rubra	red alder	ALRU
Arbutus menziesii	Pacific madrone	ARME3
Calocedrus decurrens	incense cedar	CADE3
Castanopsis chrysophylla	chinquapin	CACH2
Chamaecyparis lawsoniana	Port Orford cedar	CHLA
Cornus nuttallii	Pacific dogwood	CONU
Juniperus occidentalis	western juniper	JUOC
Lithocarpus densiflorus	tanoak	LIDE2
Picea breweriana	Brewer's spruce	PIBR
Pinus attenuata	knobcone pine	PIAT
Pinus contorta	lodgepole pine	PICO
Pinus jeffreyi	Jeffrey pine	PIJE
Pinus lambertiana	sugar pine	PILA
Pinus monticola	western white pine	PIMO3
Pinus ponderosa	ponderosa pine	PIPO
Pinus sabiniana	grey pine	PISA
Pseudotsuga menziesii	Douglas-fir	PSME
Quercus chrysolepis	canyon live oak	QUCH2
Quercus garryana	Oregon white oak	QUGA2
Quercus kelloggii	black oak	QUKE
Rhamnus purshiana	cascara buckthorn	RHPU2
Salix delnortensis	Del Norte willow	SADE
Sequoia sempervirens	redwood	SESE
Taxus brevifolia	Pacific yew	TABR
Tsuga heterophylla	western hemlock	TSHE
Umbellularia californica	California Bay	UMCA1

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Shrub Species

Acer circinatum	vine maple	ACCI
Amelanchier alnifolia	Pacific serviceberry	AMAL
Amelanchier florida	western serviceberry	AMFL
Arctostaphylos canescens	hoary manzanita	ARCA5
Arctostaphylos columbiana	hairy manzanita	ARCO6
Arctostaphylos hispidula	Howell's manzanita	ARHI
Arctostaphylos nevadensis	pinemat manzanita	ARNE2
Arctostaphylos patula	greenleaf manzanita	ARPA9
Arctostaphylos spp.	manzanita	ARC5
Arctostaphylos uva-ursi	kinnikinnik	ARUVC
Arctostaphylos viscida	whiteleaf manzanita	ARVI3
Berberis aquifolium	tall Oregongrape	BEAQ
Berberis nervosa	dwarf Oregongrape	BENE1
Berberis pumila	pygmy hollygrape	BEPU
Berberis repens	creeping Oregongrape	BERE
Ceanothus cordulatus	whitethorn	CECO2
Ceanothus cuneatus	buckbrush	CECU
Ceanothus integerrimus	deer brush	CEIN
Ceanothus prostratus	squawcarpet	CEPR
Ceanothus pumilus	Siskiyou mat	CEPU1
Ceanothus velutinus	snow brush	CEVE3
Corylus cornuta var. californica	California hazelnut	COCOC
Cytisus scoparius	scotch broom	CYSC
Eriodictyon californicum	yerba santa	ERCA6
Garrya buxifolia	dwarf silktassel	GABU2
Garrya fremontii	Fremont's silktassel	GAFR
Gaultheria ovatifolia	slender salal	GAOV
Gaultheria shallon	salal	GASH
Heteromeles arbutifolia	toyon	HEAR2
Holodiscus discolor	ocean spray	HODI
Holodiscus discolor delnortensis	Del Norte oceanspray	HODID
Juniperus communis	common juniper	JOCO
Ledum glandulosum	labrador tea	LEGL1
Lithocarpus densifloraus var.*echinoides*	dwarf tanbark	LIDEE
Lonicera ciliosa	orange honeysuckle	LOCI2
Lonicera hispidula vacillans	pink honeysuckle	LOHIV
Paxistima myrsinites	Oregon boxwood	PAMY
Philadelphus lewisii gordonianus	Gordon mock-orange	PHLEG

Prunus emarginata	bitter cherry	PREM
Quercus garryana var. breweri	Brewer's oak	QUGAB
Quercus sadleriana	Sadler oak	QUSA
Quercus vaccinifolia	huckleberry oak	QUVA
Rhamnus californica	coffeeberry	RHCA2
Rhododendron macrophyllum	Pacific rhododendron	RHMA
Rhododendron occidentale	western azalea	RHOC
Rhus diversiloba	poison oak	RHDI
Ribes lobbii	Lobb's gooseberry	RILO
Ribes sanguineum	red-flowering current	RISA
Ribes spp.	current gooseberry	RIB
Rosa gymnocarpa	wood rose	ROGY
Rosa pisocarpa	cluster rose	ROPI
Rosa spp.	rose	ROS
Rubus leucodermis	western raspberry	RULE
Rubus parviflorus	thimbleberry	RUPA2
Rubus spectabilis	salmon berry	RUSP2
Rubus ursinus	Pacific blackberry	RUUR
Salix delnortensis	Del Norte willow	SADE2
Salix lasiolepis	arroyo willow	SALA3
Salix spp.	willow	SAL11
Spirea densiflora	mountain spirea	SPDE
Spirea douglasii	rose spirea	SPDO
Symphoricarpus mollis	creeping snowberry	SYMO
Vaccinium ovatum	evergreen huckleberry	VAOV
Vaccinium parvifolium	red huckleberry	VAPA
Vaccinium scoparium	grouse huckleberry	VASC
Vaccinium membranaceum	thinleaf huckleberry	VAME

Herb and Fern Species

Achillea lanulosa	mountain yarrow	ACLA2
Achillea millefolium	common yarrow	ACMI
Achlys triphylla	vanilla leaf	ACTR
Adenocaulon bicolor	trailplant	ADBI
Adiatum pedatum var. *aleuticum*	five-finger fern	ADPEA
Allium falcifolium	falcate onion	ALFA
Allium siskiyouense	Siskiyou onion	ALSI1
Allium spp.	onion	ALL2
Allotropa virgata	candystick	ALVI2
Anagallis arvensis	scarlet pimpernel	ANAR2

Anemone deltoidea	threeleaf anemone	ANDE
Anemone quinequefolia var. *minor*	wind flower	ANQUM
Angelica arguta	sharp toothed angelica	ANAR3
Antennaria suffrutescens	evergreen everlasting	ANSU2
Apocynum androsaemifolium	spreading dogbane	APAN
Apocynum pumilum	mountain dogbane	APPU
Aquilegia formosa	red columbine	AQFO
Arabis aculeolata	Waldo rock-cress	ARAC
Arabis koehleri var. stipitata	Koehler's stipitate rockcress	ARKOS
Arabis macdonaldiana	McDonald's rockcress	ARMC
Arabis serpentinicola	Preston Peak rockcress	ARSE
Arabis suffrutescens	woody rockcress	ARSU-3
Arabis subpinnatifida	rockcress	ARSU-2
Arabis spp.	rockcress	ARA81
Arenaria spp.	sandwort	ARE81
Arnica cernua	serpentine arnica	ARCE
Arnica discoidea	rayless arnica	ARDI3
Arnica spp.	arnica	ARN80
Arnica spathulata	Klamath arnica	ARSP1
Asarum caudatum	wild ginger	ASCA2
Asarum hartwegii	marbled ginger	ASHA
Asarum spp.	ginger	ASA
Asclepias solanoana	serpentine milkweed	ASSO
Aspidotis californica	California lace fern	ASCA1
Aspidotis densa	Indian's dream	ASDE6
Aster occidentalis	western aster	ASOC
Aster spp.	aster	AST81
Astragalus deanei	Dean's milkvetch	ASDE
Balsamorhiza sagittata	balsam root	BASA1
Boschniakia strobilacea	ground cone	BOST2
Brodiaea elegans	harvest brodiaea	BREL
Brodiaea ida-maia	firecracker flower	BRID
Calochortus tolmiei	Tolmie's star tulip	CATO
Caltha howellii	marsh marigold	CAHO2
Calypso bulbosa	fairy-slipper	CABU2
Calystegia occidentalis ssp. occidentalis	false bindweed	CAOCO
Campanula prenanthoides	California harebell	CAPR6
Campanula scouleri	Scouler's harebell	CASC4
Cardamine spp.	bittercress	CAR4
Cardamine nuttallii ssp. gemmata	yellow-tubered toothwort	CANUG
Castilleja hispida ssp. brevilobata	shortlobe Indian paintbrush	CABR9
Castilleja miniata ssp. elata	Siskiyou Indian paintbrush	CAEL2

Castilleja spp.	Indian paintbrush	CAS83
Cephalanthera austiniae	Phantom orchid	CEAU
Chaenactis douglasii	chaenactis	CHDO-1
Cheilanthes gracillima	lace lipfern	CHGR1
Chimaphila menziesii	little prince's pine	CHME2
Chimaphila umbellata var. *occidentalis*	western prince's pine	CHUMO
Chlorogalum pomeridiatum	soap plant	CHPO1
Cicuta douglasii	Douglas' water hemlock	CIDO
Cirsium occidentale	western thistle	CIOC1
Cirsium spp.	thistle	CIR4
Cirsium vulgare	bull thistle	CIVU
Clarkia amoena	herald of summer	CLAM
Clarkia gracilis	slender clarkia	CLGR
Claytonia parviflora	streambank springbeauty	CLPA5
Claytonia perfoliata	miner's lettuce	CLPE
Claytonia sibirica	candyflower	CLSI2
Clintonia uniflora	Queen's cup	CLUN2
Collinsia linearis	mountain trumpet	COLI1
Collinsia spp.	collinsia	COL4
Collomia heterophylla	varied leaved collomia	COHE2
Convolvulus polymorphus	false bindweed	COPO
Convolvulus spp.	morning glory	CON6
Coptis laciniata	cutleaf goldthread	COLA2
Corallorhiza maculata	spotted coral-root	COMA4
Corallorhiza mertensiana	western coral-root	COME
Corallorhiza spp.	coral-root	COR2
Corallorhiza striata	striped coral-root	COSTQ
Cordylanthus tenuis ssp. *viscidus*	slender bird's beak	COTEH
Crepis monticola	mountain hawksbeard	CRMO2
Crepis pleurocarpa	nakedstem hawksbeard	CRPL
Cryptantha intermedia	common cryptantha	CRIN4
Cynoglossum grande	Pacific hound's tongue	CYGR
Cynoglossum occidentale	western hound's tongue	CYOC
Cypripedium californica	California lady-slipper	CYCA2
Cypripedium fasciculatum	clustered lady's-slipper	CYFA
Darlingtonia californica	California pitcher-plant	DACA2
Daucus carota	Queen Anne's lace	DACA3
Delphinium spp.	delphinium	DEL81
Dentaria californica	California toothwort	DECA4
Dentaria californica cardiophylla	toothwort	DECAC
Dentaria spp.	toothwort	DEN1
Dicentra formosa ssp. oregana	Oregon bleeding heart	DIFOO

Disporum hookeri	Hooker's fairybell	DIHO2
Disporum smithii	Smith's fairybell	DISM
Draba carnosula	Mount Eddy draba	DRCA
Drosera rotundifolia	roundleaf sundew	DRRO
Eburophyton austinae	phantom orchid	EBAU
Epilobium oreganum	Oregon fireweed	EPOR
Epilobium ridgidum	Siskiyou Mountain willowherb	EPRI
Epilobium siskiyouense	Siskiyou fireweed	EPSI
Epilobium spp.	fireweed	EPI81
Erigeron bloomeri var. *nudatus*	Waldo daisy	ERBLN
Erigeron foliosus	leafy fleabane	ERFO
Erigeron foliosus var. *confinis*	leafy fleabane	ERFOC
Eriogonum spp.	buckwheat	ERI84
Eriogonum hirtellum	Klamath Mountain buckwheat	ERHI
Eriogonum nudum	naked buckwheat	ERNU3
Eriogonum pendulum	Waldo buckwheat	ERPE5
Eriogonum ternatum	ternate buckwheat	ERTE4
Eriophyllum lanatum	woolly eriophyllum	ERLA6
Eriophyllum lanatum var. lanceolatum	common woolly sunflower	ERLAL1
Erodium botrys	storksbill	ERBO
Erysimum capitatum	western wallflower	ERCA-3
Erythronium californicum	California fawn-lily	ERCA4
Erythronium citrinum	lemon-colored fawn-lily	ERCI3
Erythronium spp.	adder's tongue fawn-lily	ERY5
Fragaria californica	California strawberry	FRCA1
Frasera albicaulis (Swertia albicaulis)	elkweed	FRAL1
Fritillaria recurva	scarlet missionbells	FRRE
Fritillaria glauca	Siskiyou missionbells	FRGL
Galium ambiguum ssp. *siskiyouense*	Siskiyou bedstraw	GAAMS
Galium californicum	California bedstraw	GACA1
Galium spp.	bedstraw	GAL2
Gayophytum nuttallii	Nuttall's gayophytum	GANU1
Gentiana affinis var. *ovata*	gentian	GEAF
Gentiana setigeria	bog gentain	GESE
Geranium dissectum	cut-leaved Geranium	GEDI
Githopsis specularioides	common bluecup	GISP2
Goodyera oblongifolia	rattlesnake plantain	GOOB
Habenaria spp.	rein-orchid	HAB
Habeneria unalascensis	Alaska bog-orchid	HAUN1
Hastingia alba	white rush lily	HAAL2
Hastingia serpentinicola	Klamath rush lily	HASE2
Helenium bigelovii	Bigelow's sneezeweed	HEBI

Hemitomes congestum	gnome-plant	HECO1
Heuchera micrantha v. *erubescens*	smallflower alumroot	HEMIE
Hieracium albiflorum	white hawkweed	HIAL
Hieracium greenei	Greene's hawkweed	HIGR2
Horkelia congesta ssp. *nemorosa*	Josephine horkelia	HOCON
Horkelia sericata	Howell's horkelia	HOSE
Hypericum anagalloides	trailing St. Johnswort	HYAN
Hypericum perforatum	Klamath weed	HYPE
Iris bracteata	Siskiyou iris	IRBR
Iris chrysophylla	slender-tubed iris	IRCH
Iris innominata	Del Norte County iris	IRIN
Iris purdyi	Purdy's iris	IRPU
Iris spp.	iris	IRI
Kelloggia galioides	milk kelloggia	KEGA
Lathyrus biflorus	two-flowered pea	LABI
Lathyrus delnorticus	Del Norte pea	LADE
Lathyrus nevadensis	Sierra Nevada pea	LANE
Lathyrus sp.	pea	LAT3
Lewisia leana	Lee's bitterroot	LELE4
Lewisia oppositifolia	opposite-leaved lewisia	LEOP
Ligusticum apiifolium	celeryleaf licoriceroot	LIAP
Ligusticum californicum	Californonia licoriceroot	LICA1
Lilium bolanderi	Bolander's lily	LIBO1
Lilium pardilinum	leopard lily	LIPA1
Lilium spp.	lily	LIL2
Lilium volmeri	Volmer's lily	LIVO
Lilium washingtonianum purp.	Washington lily	LIWAP
Linnaea borealis var. *longiflora*	western twinflower	LIBOL
Listera caurina	western twayblade	LICA4
Lomatium californicum	lomatium	LOCA-1
Lomatium dissectum	fernleaf lomatium	LODI
Lomatium howellii	Howell's lomatium	LOHO
Lomatium macrocarpum	bigseed biscuitroot	LOMO3
Lomatium spp.	lomatium	LOM80
Lomatium tracyi	Tracy's lomatium	LOTR
Lomatium triternatum v. *triternatum*	nineleaf biscuitroot	LOTRT
Lonicera hispidula var. *vacillans*	hairy honeysuckle	LOHIV
Lotus crassifolius	big deervetch	LOCR
Lotus oblongifolius	birdsfoot trefoil	LOOB
Lotus spp.	lotus	LOT81
Lupinus constancei	Lassics' lupine	LUCO1
Lupinus lepidus	dwarf lupine	LULE

Lupinus onustus	Plumas lupine	LUON
Lupinus spp.	lupine	LUP1
Madia elegans	common madia	MAEL
Madia madioides	woodland tarweed	MAMA1
Madia spp.	tarweed	MAD3
Medicago polymorpha	California burclover	MEPO
Mentha spicata v. *spicata*	spearmint	MESP2
Microseris howellii	Howell's silverpuffs	MIHO
Micorseris laciniata	cutleaf silverpuffs	MILA
Minuartia decumbens	Lassics' sandwort	MIDE
Minuartia howellii	Howell's sandwort	MIHO
Monardella odoratisima	mountain pennyroyal	MOOD
Moneses uniflora ssp. *reticulata*	single delight	MOUNR
Montia parvifolia	littleleaf minerslettuce	MOPA2
Narthecium californicum	bog asphodel	NACA
Nemophila peduncularis	meadow nemophila	NEPE
Oenothera spp.	evening primrose	OEN81
Osmorhiza chilensis	mountain sweet-cicely	OSCH
Osmorhiza spp.	sweet-cicely	OSM
Oxalis oregana	redwood sorrel	OXOR1
Parnassia palustris ssp. *californica*	farewell to spring	PAPAC
Pedicularis densiflora	Indian warrior	PEDE1
Penstemon abquineus	tongue-leaved penstemon	PEAN
Perideridia spp.	yampah	PER2
Perideridia oregana	squaw potato	PEOR2
Petasites palmatus	western coltsfoot	PEPA2
Phacelia corymbosa	serpentine scorpionweed	PHCO3
Phlox adsurgens	woodland phlox	PHAD2
Phlox diffusa	spreading phlox	PHDI4
Phlox spp.	phlox	PHL80
Pinguicula vulgaris ssp. *macroceras*	butterwort	PIVUM
Platanthera sparsifolia	sparse flowered bog orchid	PLSP
Polygala californica	California milkwort	POCA8
Polygala cornuta	Sierra milkwort	POCO6
Polygonum confertiflorum	willowherb	POCO-4
Polypodium californicum	California polypody	POCA1
Polypodium glycyrrhiza	licorice-fern	POGL1
Polystichum munitum	swordfern	POMU1
Polystichum munitum ssp. imbricans	imbricate swordfern	POMUI
Potentilla glandulosa	common cinquefoil	POGL-2
Prunella vulgaris	selfheal	PRVU
Pteridium aquilinum v. *lanuginosum*	bracken fern	PTAQL

Pterospora andromedea	pinedrops	PTAN
Pyrrocoma racemosa v. *congesta*	Del Norte happlopappus	PYRAC
Pyrola asarifolia var. *bracteata*	large wintergreen	PYASB
Pyrola picta	white veined wintergreen	PYPI
Pyrola picta ssp. *dentata*	Nootka wintergreen	PYPID
Pyrola secunda	one sided wintergreen	PYSE
Ranunculus occidentalis	western buttercup	RAOC
Ranunculus spp.	buttercup	RAN3
Rudbeckia californica ssp. glauca	California cone flower	RUCAG
Sanguisorba officianalis	great burnet	SAOC
Sanicula peckiana	Peck's sanicle	SAPE
Sanicula spp.	sanicle	SAN4
Sarcodes sanquinea	snowplant	SASA3
Satureja douglasii	yerba buena	SADO1
Sedum laxum ssp. *flavidum*	paleyellow stonecrop	SELAF
Sedum laxum ssp. *heckneri*	Heckner's stonecrop	SELAH
Sedum laxum ssp. *laxum*	stonecrop	SELAL2
Sedum spp.	stonecrop	SED
Sedum spathulifolium	spatula-leaf stonecrop	SEOBR
Senecio lingifolius (S.macounii)	Siskiyou Mountian ragwort	SELI
Sidalcea diploscypha	fringed checkermallow	SIDI1
Sidalcea malvaeflora	checkermallow	SIMA1
Silene campanulata	Red Mountain catchfly	SICA3
Silene hookeri	Hooker's silene	SIHO
Silene spp.	catchfly/campion	SIL3
Sisyrinchium bellum	blue-eyed grass	SIBE
Sisyrinchium idahoensis	Idaho blue-eyed grass	SIID
Smilacina racemosa amplexicaulis	western Solomon-seal	SMRAA
Stellaria jamesiana	sticky starwort	STJA
Taraxacum officianale	common dandelion	TAOF
Taraxacum sp.	dandelion	TAR
Tauschia glauca	glaucous tauschia	TAGL
Tellima grandiflora	Alaska fringecup	TEGE
Thermopsis macrophylla	California goldenbanner	THMA
Thlaspi californicum	Kneeland pennycress	THCA
Thlaspi montanum v. montanum	alpine pennycress	THMOM
Tofieldia glutinsa occidentalis	western tofieldia	TOGLO
Torilis arvensis	field hedge parsley	TOAR
Trientalis latifolia	western starflower	TRLA3
Trifolium breweri	forest clover	TRBR
Trifolium longipes	long-stalked clover	TRLO
Trifolium repens	white clover	TRRE

Trifolium sp.	clover	TRI11
Trillium ovatum	white trillium	TROV2
Trillium rivale	Oregon trillium	TRRI
Tritelia bridgesii	Bridge's brodiaea	TRBR2
Valeriana sitchensis	mountain valerian	VASI
Vancouveria chrysantha	yellow inside-out flower	VACH
Vancouveria hexandra	western vancouveria	VAHE
Vancouveria planipetala	small inside-out flower	VAPL
Veratrum californicum	California false hellebore	VECA1
Veratrum insolitum	Siskiyou false hellebore	VEIN
Veratrum sp.	false hellebore	VER1
Vicia californica	California vetch	VICA1
Vicia sp.	vetch	VIC3
Viola glabella	stream violet	VIGL
Viola lobata	pine violet	VILO
Viola ocellata	western heart's ease	VIOC
Viola primulifolia ssp. occidentalis	western bog violet	VIPRO2
Viola sempervirens	redwood violet	VISE
Viola sheltonii	Shelton's violet	VISH
Viola sp.	violet	VIO3
Whipplea modesta	western modesty	WHMO
Xerophyllum tenax	beargrass	XETE
Zigadenus micranthus	death camas	ZIMI

Sedge and Grass Species

Aira caryophylla	hairgrass	AIRA
Arrhenatherum elatus	tall oatgrass	AREL1
Avena fatua	wild oats	AVFA
Bromus carinatus	California brome	BRCA1
Bromus marginatus	large mountain brome	BRMA3
Bromus spp.	brome	BRO3
Bromus tectorum	cheatgrass	BRTE
Bromus vulgaris	Columbia brome	BRVU
Calamagrostis koelerioides	fire reedgrass	CAKO
Carex concinnoides	northwestern sedge	CACO2
Carex echinata	prickley sedge	CAEC
Carex gigas	elkgrass	CAGI
Carex mendocinensis	Mendocino sedge	CAME1
Carex multicostata	many rib sedge	CAMU2
Carex ormantha	western stellate sedge	CAOR

Carex spp.	sedge	CAR1
Cynosurus echinatus	dogtail grass	CYEC
Dactylis glomerata	orchard grass	DAGL1
Danthonia californica var. californica	California oatgrass	DECAC
Danthonia unispicata	one-spiked oatgrass	DAUN
Deschampsia elongata	slender hairgrass	DEEL
Elymus caput-medusae	Medusa head	ELCA2
Elymus glaucus	blue wild rye	ELGL
Elymus multisetus	big squirrel tail	ELMU
Festuca californica	California fescue	FECA
Festuca idahoensis	Idaho fescue	FEID
Festuca occidentalis	western fescue	FEOC1
Festuca spp.	fescue	FES3
Festuca rubra	red fescue	FERU
Festuca subulata	bearded fescue	FESU1
Festuca subuliflora	crinkle-awn fescue	FESU2
Hierochloe occidentalis	California sweetgrass	HIOC
Juncus effusus var. gracilis	common rush	JUEFG
Juncus ensifolius	swordleaf rush	JUEN
Juncus phaeocephalus	brownhead rush	JUPH
Luzula comosa	heath woodrush	LUCO1
Luzula parviflora	small flowered woodrush	LUPA1
Melica aristata	bearded oniongrass	MEAR1
Melica geyeri	Geyer's oniongrass	MEGE
Melica spp.	oniongrass	MEL1
Melica subulata	Alaska oniongrass	MESU
Panicum acuminatum	panic	PAAG
Poa piperi	timber bluegrass	POPI
Poa pratensis	Kentucky bluegrass	POPR1
Poa sp.	bluegrass	POA3
Scirpus criniger (Eriophorum c.)	cottongrass	SCCR
Sitanion hystrix(Elymus elamoides)	squirreltail	SIHY
Stipa lemmonii	lemon stipa	STLE1

APPENDIX II: ENVIRONMENTAL SUMMARY

Environmental Summary

PLANT ASSOCIATION	ELEVATION mean/range	ASPECT	PERCENT SLOPE mean/range	SLOPE POSITION	RADIATION INDEX mean/range	SURFACE ROCK mean/range	DISTANCE TO OCEAN (miles)
PIJE/FEID	2002 (1740-2440)	S.E.,S.W.	14 (3-30)	up 1/3,ridge	.500 (.424-.553)	18 (1-50)	10.4
PIJE/QUVA-ARNE2/FEID	4379 (3460-5560)	W., S.,	22 (0-40)	ridge	.505 (.451-.569)	37(10-70)	21.5
PIJE-PSME/QUVA/FECA	3614 (1840-5560)	N.E.,S.W.	34 (8-65)	mid,up 1/3,ridge	.480 (.394-.561)	12 (0-25)	25.6
PIJE-ABCO/IRI	5155 (4100-6300)	S.,E.,N.	29 (0-67)	up 1/3,ridge	.520 (.407-.598)	4 (0-10)	31.4
PIJE-ABCO/QUSA/XETE	3746 (3280-4000)	E.,S.,W.	19 (5-37)	up 1/3,ridge	.470 (.371-.553)	2 (0-3)	18.5
PIJE-CADE3/CECU-2	3467 (920-6000)	S.E.,N.E.	33 (10-55)	mid,up1/3,ridge	.510 (.390-.586)	17 (3- 25)	31.5
PIJE-CADE3/CEPU	5022 (4560-5340)	S.W.,S.	25 (0-40)	Up 1/3,lower 1/3	.500 (.359-.558)	17 (4-85)	36.8
PIJE-CADE3/QUVA/XETE	4148 (2600-4800)	S.,S.E.	30 (0-55)	mid,up1/3,ridge	.490 (.301-.572)	41 (3-85)	20.9
PIJE-CADE3-ABCO/QUVA	4522 (2670-5180)	W.,S.E.	27 (5-50)	up1/3,ridge	.480 (.285-.548)	10 (1-35)	30.8
PSME-UMCA/RHDI	1490 (610-2450)	S.W.,N.E.	41 (10-65)	mid,low1/3	.493 (.462-.565)	7 (0-13)	26.7
PSME-LIDE2/QUVA-HODI	3113 (2430-3600)	N.E.,S.W.,N.	41(20-60)	up, mid1/3	.428 (.272-.537)	41 (5-80)	20.0
PSME-CADE3/FECA	2470 (1360-2750)	S.,W.	39 (20-65)	up,mid1/3	.466 (.336-.582)	3 (1-9)	24.4
PSME-PIJE/FECA	2953 (1740-4240)	N.W.,S.E.,W.	37 (25-58)	up,mid1/3	.451 (.370-.520)	2 (0-4)	33.7
PSME/QUVA	3393 (2500-4440)	N.W.,E.,S.W	50 (10-70)	up,mid,low1/3	.376 (.239-.569)	10 (1-35)	30.1
PSME/QUVA-LIDEE	3521 (3220-4040)	S.W.,N.W.	47 (30-65)	up,mid1/3	.444 (.260-.542)	17 (2-26)	19.3
PSME/QUVA-RHMA	3245 (2490-4000)	N.E.	55 (45-65)	up,low1/3	.330 (.247-.413)	9 (7-11)	21.2
CHLA/RHMA-GASH	3269 (2700-3600)	N.W.,N.E.	32 (10-60)	mid,low 1/3	.376 (.276-.460)	1 (0-7)	21.0
CHLA/RHOC	3143 (2500-3940)	N.E.	21 (5-45)	mid,low 1/3	.453 (.397-.510)	3 (0-6)	22.3
CHLA-PSME/QUVA	3425 (2520-4500)	N.W.,E.	30 (0-80)	up,mid,low 1/3,strm	.431 (.256-.563)	9 (1-30)	22.1
CHLA-CADE3-ALRH	3295 (3220-3390)	S.E.	38 (25-50)	mid,low 1/3	.542 (.527-.556)	4 (2-5)	21.8
CHLA-PIMO3/QUVA	2964 (1500-3840)	E.,W.	32 (5-70)	mid,low 1/3,strm	.450 (.307-.553)	14 (4-25)	22.4

PLANT ASSOCIATION	ELEVATION mean/range	ASPECT	PERCENT SLOPE mean/range	SLOPE POSITION	RADIATION INDEX mean/range	SURFACE ROCK mean/range	DISTANCE TO OCEAN (miles)
CHLA-ABCO/QUVA	3913 (2980-4620)	N.E.,E.	38 (17-68)	mid,low 1/3	.451 (.410-.499)	5 (0-7)	28.7
CHLA-ABCO-PIMO3/QUVA	4756 (4360-5180)	N.W.,W.	27 (15-45)	mid,low1/3,strm	.410 (.321-.416)	7 (1-18)	29.2
CHLA-ABCO/RHOC	4040 (3220-4850)	N.E.,S.	31 (10-75)	mid,low 1/3	.461 (.275-.588)	4 (1-9)	28.1
PILA-CACH2/QUVA-QUSA	3952 (3350-4620)	E.,S.	33 (20-45)	up1/3	.520 (.474-.583)	12 (2-25)	14.9
PILA-PICO1/QUVA-LIDEE	3340 (2000-3980)	S.,W.	23 (10-45)	ridge, up, mid 1/3	.510 (.448-.559)	29(21-50)	16.3
PILA-PICO1/LIDEE-RHMA	2777 (2100-3280)	N.E	27 (5-40)	low1/3	.397 (.334-.473)	13(10-20)	17.8
PILA-PIMO3/QUVA-GABU	24556 (4420-4800)	N.E.	29 (5-50)	ridge, up 1/3	.410(.308-.481)	57(40-75)	21.2
PIMO3-PILA/QUVA-LIDEE	3249 (2200-3820)	E.,W.	30 (7-55)	up,mid1/3	.470 (.397-.584)	34 (1-67)	14.8
PIMO3-PSME/QUVA-LIDEE	3522 (2700-4100)	S.,E.,W.	34 (20-65)	ridge,up1/3	.470 (.326-.582)	74(50-95)	18.0
PIMO3-PICO1/LIDEE-RHMA	3088 (1800-3800)	N.,S.,W.	17 (2-28)	up,mid 1/3	.460 (.373-.504)	31 (3-55)	15.2
CEPU1/FEID//Serp. Barren	2904 (1560-4000)	S.,W.	23 (2-40)	up,mid1/3	.500 (.384-.577)	35 (3-45)	21.2
DACA2//Bog	1681 (390-2700)	S.W.	33 (5-85)	low1/3	.476 (.340-.591)	12 (1-21)	21.2

APPENDIX III: SOIL SUMMARY

Soil Summary

PLANT ASSOCIATION	SOIL DEPTH mean/range	AWC mean/range	A-HORIZON THICKNESS mean/range	A-HORIZON COARSE FRAG mean/range	TEXTURE	PARENT MATERIAL	SURFACE pH
PIJE/FEID	21" (11-40+)	2.1" (0.9-5.6)	7" (2-14)	25% (10-62)	gl,l	serp,per	7.3
PIJE/QUVA-ARNE2/FEID	16" (2-28)	1.6" (0.2-2.7)	5" (2-9)	22% (10-45)	l,sl	serp,per	7.5
PIJE-PSME/QUVA/FECA	21" (9-43)	2.3" (1.2-2.6)	4" (1-10)	27% (20-30)	gl,gcl	serp,per	6.7
PIJE-ABCO/IRI	33" (18-40+)	3.2" (1.1-5.5)	13" (3-25)	32% (15-58)	l,gl,vgl	san	6.0
PIJE-ABCO/QUSA/XETE	34" (33-37)	2.6" (2.0-3.0)	6" (2-11)	16% (5-20)	gl,l	sch,per,silt	6.3
PIJE-CADE3/CECU2	32" (15-40+)	2.4" (1.3-4.0)	9" (2-11)	22% (10-50)	gl,sl	serp,per	6.9
PIJE-CADE3/CEPU	21" (4-40+)	2.0" (0.9-4.0)	4" (1-14)	23% (12-45)	gl,l	serp,per	7.2
PIJE-CADE3/QUVA/XETE	25" (16-40+)	1.8" (0.7-3.3)	5" (1-9)	40% (15-70)	vgl,gl	serp,per	6.4
PIJE-CADE3-ABCO/QUVA	24" (11-40+)	2.1" (0.5-4.1)	5" (1-14)	32% (7-62)	gl,vgl,vgcl	serp,per	6.4
PSME-UMCA/RHDI	37" (28-40+)	1.6" (0.6-2.3)	12" (2-38)	33% (20-40)	vgl,gl	serp	6.5
PSME-LIDE2/QUVA-HODI	34" (27-40+)	1.2" (0.7-1.6)	6" (4-7)	53% (35-75)	gl,vgl	serp	6.3
PSME-CADE3/FECA	30" (14-40+)	2.0" (1.3-2.6)	5" (2-6)	31% (20-45)	gl,vgl,gsil	serp	6.8
PSME-PIJE/FECA	32" (23-40+)	2.4" (1.7-3.2)	6" (2-9)	28% (20-34)	l,gl,gsil	serp,grn	6.3
PSME/QUVA	28" (13-40+)	1.6" (0.7-3.0)	5" (2-8)	45% (20-72)	vgl,gl,vgsl,gsil	per,serp	6.4
PSME/QUVA-LIDEE	24" (12-35)	1.6" (0.5-2.4)	6" (2-8)	36% (20-45)	vgl,gl	per,serp	6.0
PSME/QUVA-RHMA	17" (15-20)	1.8" (0.8-2.8)	1" (1-2)	25% (10-40)	l,vgl	serp	6.1
CHLA/RHMA-GASH	36" (22-40+)	3.9" (2.1-6.5)	5" (2-12)	32% (15-45)	gl,vgl,vgcl	phy,grn,serp	6.0
CHLA/RHOC	38" (33-40+)	5.4" (2.4-7.1)	5" (2-7)	25% (10-35)	l,gl,vgl	serp,per,gne,san	6.8
CHLA-PSME/QUVA	34" (15-40+)	3.3" (1.3-4.8)	5" (1-13)	31% (20-55)	gl,vgl,gsil	serp,per	6.8
CHLA-CADE3-ALRH	38" (35-40+)	3.3" (2.7-3.9)	6" (5-7)	40% (35-45)	vgl	sch,mix	6.3
CHLA-PIMO3/QUVA	27" (15-40+)	1.8" (1.1-2.4)	5" (1-8)	62% (30-90)	xgl,vgl,gsl	serp,per	6.5

PLANT ASSOCIATION	SOIL DEPTH mean/range	AWC mean/range	A-HORIZON THICKNESS mean/range	A-HORIZON COARSE FRAG mean/range	A-HORIZON TEXTURE	PARENT MATERIAL	SURFACE pH
CHLA-ABCO/QUVA	30" (9-40+)	2.6" (1.0-3.7)	6" (2-14)	42% (25-52)	gl,vgl	serp,per,grn	6.7
CHLA-ABCO-PIMO3/QUVA	29" (14-40+)	2.5" (1.2-3.9)	6" (3-8)	43% (16-85)	vgl,gl,xgl	serp,per	6.2
CHLA-ABCO/RHOC	37" (25-40+)	4.1" (2.2-5.5)	6" (2-12)	28% (10-46)	gl,vgl	serp,per	6.5
PILA-CACH2/QUVA-QUSA	24" (32-40+)	1.7" (0.6-2.9)	3" (3-8)	24% (17-30)	sl,gl	san	6.4
PILA-PICO1/QUVA-LIDEE	23" (10-40+)	2.1" (0.7-3.5)	5" (3-8)	32% (20-60)	sil,scl,gl	serp	6.7
PILA-PICO1/LIDEE-RHMA	14" (15-32)	2.4" (2.2-2.8)	6" (4-7)	22% (10-40)	sil,gl,l	serp	7.0
PILA-PIMO3/QUVA-GABU2	27" (12-37)	1.4" (1.2-1.8)	7"(5-10)	42% (20-65)	xkl,vgl,gl	serp,per	6.9
PIMO3-PILA/QUVA-LIDEE	32" (22-40+)	2.3" (1.8-3.3)	6" (3-10)	35% (15-60)	l,gl,vgl	serp	6.8
PIMO3-PSME/QUVA-LIDEE	29" (20-40+)	2.1" (1.3-3.6)	5" (2-8)	32% (10-50)	gcl,stcl,sl	serp	6.9
PIMO3-PICO1/LIDEE-RHMA	31" (14-40+)	2.6" (1.8-3.9)	6" (2-12)	30% (10-40)	gl,vgl	serp	6.8
CEPU1/FEID//Serp. Barren	4" (2-11)	0.3" (0.1-0.5)	3" (1-9)	34% (8-41)	gl,vgsl	serp	6.9
DACA2//Bog	8" (0-14)	0.3" (0.1-0.9)	7" (3-14)	9% (5-12)	l,vgl,gl	serp	5.4

*Parent material abbreviations: maf=mafic, grn=greenstone, serp=serpentine, phy=phyllite, sch=schist, san=sandstone, gne=gneiss, per=peridotite.

APPENDIX IV: STAND STRUCTURE SUMMARY

Stand Structure Summary

PLANT ASSOCIATION	CUBIC VOLUME ($ft.^3$) SOFTWOOD mean/SE	CUBIC VOLUME ($ft.^3$) HARDWOOD mean/SE	BASAL AREA ($ft.^2$) SOFTWOOD mean/SE	BASAL AREA ($ft.^2$) HARDWOOD mean/SE	STAND DUNNING SITE CLASS mode/range	STAND DENSITY INDEX mean/SE
PIJE/FEID	2250 765)	105 (105)	85 (16)	4 (4)	5 (3-5)	145 (21)
PIJE/QUVA-ARNE2/FEID	1186 (278)	0 (0)	81 (14)	0 (0)	5 (5)	145 (24)
PIJE-PSME/QUVA/FECA	3706(1260)	0 (0)	172 (31)	15 (15)	5 (4-5)	270 (66)
PIJE-ABCO/IRI	11377(1016)	120 (103)	306 (20)	7 (6)	2 (1A-4)	458 (34)
PIJE-ABCO/QUSA/XETE	5170(1049)	313 (282)	170 (4)	25 (17)	3 (3-4)	350(112)
PIJE-CADE3/CECU-2	4378(1307)	259(159)	172(43)	14(8.0)	2,4 (2-4)	294(64)
PIJE-CADE3/CEPU-1	1935 (373)	112 (75)	97 (17)	6 (4)	5 (5)	145 (21)
PIJE-CADE3/QUVA/XETE	2941 (923)	0 (0)	118 (22)	0 (0)	5 (4-5)	192 (34)
PIJE-CADE3-ABCO/QUVA	6601 (738)	0 (0)	252 (19)	0 (0)	5 (3-5)	394 (36)
PSME-UMCA/RHDI	4597 (964)	1308(369)	148 (31)	67 (18)	2 (1-4)	359 (36)
PSME-LIDE2/QUVA-HODI	5325 (990)	157 (91)	210 (32)	13 (1)	3 (2-3)	331 (48)
PSME-CADE3/FECA	6748 (754)	651(311)	243 (32)	30 (14)	4 (2-4)	400 (42)
PSME-PIJE/FECA	6260(1051)	207 (136)	203 (33)	10 (7)	2 (1A-5)	350 (56)
PSME/QUVA	6259 (547)	178 (79)	213 (14)	8 (3)	3 (1-5)	316 (21)
PSME/QUVA-LIDEE	5263 (869)	140 (86)	188 (24)	6 (4)	4 (3-5)	272 (34)
PSME/QUVA-RHMA	4754 (31)	150 (150)	200 (133)	7 (7)	3 (3-4)	295(170)
CHLA/RHMA-GASH	12,498(1075)	156 (57)	338 (22)	8 (3.0)	1 (1A-3)	490 (29)
CHLA/RHOC	10751(1418)	56 (27)	313 (34)	5 (3)	3 (2-4)	498 (57)
CHLA-PSME/QUVA	9821(1132)	40 (20)	301 (26)	3 (1)	2 (1-4)	454 (38)
CHLA-CADE3-ALRH	8280(1905)	442 (442)	253 (40)	26 (26)	3 (2-3)	459 (20)

PLANT ASSOCIATION	CUBIC VOLUME ($ft.^3$) SOFTWOOD mean/SE	CUBIC VOLUME ($ft.^3$) HARDWOOD mean/SE	BASAL AREA ($ft.^2$) SOFTWOOD mean/SE	BASAL AREA ($ft.^2$) HARDWOOD mean/SE	STAND DUNNING SITE CLASS mode/range	STAND DENSITY INDEX mean/SE
CHLA-PIMO3/QUVA	6374(1201)	58 (58)	257 (38)	3 (3)	5 (3-5)	404 (62)
CHLA-ABCO/QUVA	11867(1139)	0 (0)	351 (30)	0 (0)	2 (1-3)	507 (35)
CHLA-ABCO-PIMO3/QUVA	11043(1107)	0 (0)	357 (19)	0 (0)	2 (2-3)	540 (32)
CHLA-ABCO/RHOC	11173(1028)	0 (0)	329 (18)	0 (0)	3 (2-3)	496 (34)
PILA-CACH2/QUVA-QUSA	2414 (274)	25 (15)	114 (14)	8 (3)	4 (2-4)	230 (41)
PILA-PICO1/QUVA-LIDEE	1421 (403)	0 (0)	95 (15)	0 (0)	5 (4-5)	161 (25)
PILA-PICO1/LIDEE-RHMA	352 (116)	0 (0)	127 (28)	0 (0)	5 (3-5)	302 (67)
PILA-PIMO3/QUVA-GABU2	808 (163)	0 (0)	75 (11)	0 (0)	5 (5)	144 (35)
PIMO3-PILA/QUVA-LIDEE	1217 (192)	0 (0)	95 (15)	0 (0)	5 (4-5)	177 (32)
PIMO3-PSME/QUVA-LIDEE	1258 (547)	272 (272)	142 (40)	13 (13)	5 (4-5)	379(147)
PIMO3-PICO1/LIDEE-RHMA	890 (194)	0 (0)	130 (10)	0 (0)	5 (5)	304 (26)

Stand Structure Summary T1,T2 & T3

PLANT ASSOCIATION	AGET1	DBH T1	HEIGHT T1	AGE T2	DBH T2	HEIGHT T2	AGE T3	DBH T3	HEIGHT T3
PIJE/FEID	152(11)	21.7(1.3)	76(04)	111(09)	15.3(1.3)	57(05)	97 (07)	10.8(1.3)	45(06)
PIJE/QUVA-ARNE2/FEID	198(23)	20.4(1.8)	48(04)	208(55)	18.3(3.9)	42(05)	104(49)	10.9(5.3)	26(10)
PIJE-PSME/QUVA/FECA	200(34)	23.9(2.9)	84(11)	193(23)	23.4(1.9)	79(06)	101(24)	10.6(2.2)	49(11)
PIJE-ABCO/IRI	227(18)	41.5(2.0)	126(04)	112(15)	25.2(2.0)	93(04)	146(58)	21.9(2.6)	71(06)
PIJE-ABCO/QUSA/XETE	340(61)	39.6(6.0)	141(13)	223(42)	29.3(5.3)	112(12)	82 (16)	15.3(9.1)	65(31)
PIJE-CADE3/CECU2	189(24)	31.4(1.6)	108(06)	159(21)	25.0(2.8)	76(06)	0 (0)	0 (0)	0 (0)
PIJE-CADE3/CEPU	277(19)	27.7(1.5)	70(03)	153(11)	20.6(1.2)	56(08)	94 (12)	12.7(2.4)	44(10)
PIJE-CADE3/QUVA/XETE	216(26)	25.1(1.9)	77(05)	160(22)	16.3(1.5)	52(04)	151(67)	10.9(1.8)	39(06)
PIJE-CADE3-ABCO/QUVA	254(23)	29.4(2.0)	95(05)	236(27)	23.4(2.1)	76(05)	221(44)	16.6(2.3)	51(08)
PSME-UMCA/RHDI	169(20)	33(2)	135(4)	94(19)	22(4)	79(10)	116(82)	14(12)	43(32)
PSME-LIDE2/QUVA-HODI	265(52)	33(2.0)	125(3.0)	158(24)	19(1.0)	95(6)	0 (0)	0 (0)	0 (0)
PSME-CADE3/FECA	223(18)	39.0(2.0)	132(05)	214(50)	30.0(5.0)	100(08)	100(39)	18.0(3.0)	91 (0)
PSME-PIJE/FECA	174(23)	29.0(2.0)	118(05)	134(23)	27.0(3.0)	107(10)	136(31)	15.0(6.0)	60 (17)
PSME/QUVA	297(16)	34.0(2.0)	127(05)	234(16)	26.0(1.0)	94(05)	212(53)	17.0(3.0)	61 (10)
PSME/QUVA-LIDEE	269(28)	33.0(3.0)	105(07)	250(24)	25.0(2.0)	83(05)	175(35)	16.0(3.0)	53 (7)
PSME/QUVA-RHMA	316(42)	34(5.0)	121(9.0)	223(73)	22(7.0)	84(14)	95(20)	8(2.0)	36(1.0)
CHLA/RHMA-GASH	349(26)	46.0(2.0)	155(6)	313(34)	33.0(2.0)	79(6)	221(33)	21.0(4.0)	73 (8)
CHLA/RHOC	361(27)	40.0(2.0)	143(7)	275(32)	27.0(2.0)	108(8)	213(41)	18.0(5.0)	59 (12)
CHLA-PSME/QUVA	368(28)	39.0(2.0)	134(4)	233(21)	28.0(2.0)	105(4)	145(23)	16.0(2.0)	61 (8)
CHLA-CADE3-ALRH	215(14)	42.0(3.0)	158(11)	138(30)	26.0(4.0)	113(8)	134(46)	16.0(2.0)	78 (2)
CHLA-PIMO3/QUVA	366(39)	29.0(2.0)	97(7)	270(66)	23.0(2.0)	84(13)	330(70)	26.0(3.0)	79 (12)
CHLA-ABCO/QUVA	305(19)	38.0(3.0)	131(8)	304(32)	35.0(4.0)	113(4)	247(37)	29.0(4.0)	90 (7)
CHLA-ABCO-PIMO3/QUVA	317(30)	38.0(3.0)	112(8)	300(46)	26.0(3.0)	79 (6)			

PLANT ASSOCIATION	AGET1	DBH T1	HEIGHT T1	AGE T2	DBH T2	HEIGHT T2	AGE T3	DBH T3	HEIGHT T3
CHLA-ABCO/RHOC	322(30)	38.0(3.0)	133(7)	238(25)	25.0(3.0)	101(5)	152(31)	13.0(3.0)	68 (9)
PILA-CACH2/QUVA-QUSA	249(19)	35.0(2.0)	99(05)	155(26)	27.0(2.0)	91(05)	67 (11)	18.0(9.0)	44(01)
PILA-PICO1/QUVA-LIDEE	173(20)	24.0(2.0)	73(05)	105 (4)	14.0(3.0)	52(05)	0 (0)	0 (0)	0 (0)
PILA-PICO1/LIDEE-RHMA	126(12)	10.0(1.0)	45(04)	87(26)	12.0(1.0)	53(05)	0 (0)	0 (0)	0 (0)
PILA-PIMO3/QUVA-GABU2	282(26)	29.0(2.0)	74(03)	163(21)	18.0(2.0)	52(03)	0 (0)	0 (0)	0 (0)
PIMO3-PILA/QUVA-LIDEE	160(22)	19.0(2.0)	73(04)	106(12)	13.0(1.0)	54(03)	116 (0)	14.0 (0)	51 (0)
PIMO3-PSME/QUVA-LIDEE	117(11)	12.0(2.0)	48(06)	125(31)	12.0(3.0)	43(07)	66 (0)	10.0 (0)	47 (0)
PIMO3-PICO1/LIDEE-RHMA	106(13)	11.0(1.0)	48(03)	82 (7)	8.0(1.0)	40(03)	60 (0)	6.0 (0)	27 (0)

APPENDIX V: VEGETATION SUMMARY

PLANT ASSOCIATION:	PIJE/FEID	PIJE/QUVA-ARNE2/FEID	PIJE-PSME/QUVA/FECA	PIJE-ABCO/IRI	PIJE-ABCO/QUSA/XETE	PIJE-CADE3/CECU2
	n=19	n=12	n=11	n=15	n=7	n=20
VEGETATION LAYER:			%COVER			
TOTAL COVER	82	60	86	78	97	70
GRASS COVER	63	22	36			27
FORB COVER	19	6	7	3	30	7
SHRUB COVER	10	29	41	2	55	29
TREE COVER	24	18	56	71	66	33
TREE OVERSTORY:		% COVER (CONSTANCY)				
Jeffrey Pine	22 (100)	14 (100)	25 (100)	25(100)	29 (100)	20 (100)
Douglas-fir	2 (52)	1 (41)	17 (100)	14 (40)	9 (100)	6 (75)
Incense Cedar	1 (5)	4 (33)	13 (90)	9 (71)	2 (14)	9 (80)
Sugar Pine			6 (63)	9 (60)	12 (85)	10 (10)
California bay	1 (26)		1 (18)		2 (10)	
Western White Pine	1 (5)	3 (50)	6 (18)			
White Fir				30(100)	11 (57)	
Pacific Madrone	1 (15)		1 (27)		3 (25)	
Chinquapin				15 (13)	26 (57)	
Lodgepole Pine		6 (33)	1 (9)			
Knobcone Pine	2 (21)		12 (18)	1 (6)		1 (5)
Pacific Yew						
Port Orford Cedar			1 (18)			
Tanoak						
White Alder						
Bigleaf Maple						
Canyon Live Oak			1 (27)	1 (13)		3 (40)
White Oak						2 (20)
Black Oak						
Brewer's Spruce						
Red Fir						

TREE UNDERSTORY:	% COVER (CONSTANCY)					
Jeffrey Pine	1 (100)	1 (100)	2 (100)	1 (35)	9 (71)	1 (95)
Lodgepole Pine	15 (5)	2 (16)				
Douglas-fir	1 (31)	1 (41)	1 (100)	1 (33)	1 (100)	1 (60)
Incense Cedar	1 (5)	1 (50)	2 (81)	3 (46)	3 (28)	2 (75)
Sugar Pine			2 (27)	1 (33)	3 (100)	3 (10)
White fir				3(100)	3 (71)	1 (10)
Tanoak						1 (10)
White Oak				3 (6)		1 (10)
Black Oak				1 (6)		1 (5)
California bay	1 (10)		8 (9)			
Canyon Live Oak			1 (9)	4 (46)		1 (35)
Chinquapin				3 (20)	1 (71)	
Western White Pine	1 (5)	1 (41)	1 (9)			
Pacific Yew						
Port Orford Cedar			3 (18)			
White Alder						
Bigleaf Maple						
SHRUBS:	% COVER (CONSTANCY)					
Squawcarpet	2 (100)	4 (25)	10 (18)		2 (28)	
Pinemat Manzanita	4 (84)	13 (83)	8 (54)		34 (57)	
Oceanspray	2 (89)	2 (16)	5 (9)	2 (13)		2 (14)
Huckleberry Oak	3 (57)	11 (75)	29 (100)	1 (6)	1 (28)	10 (5)
Common Juniper	2 (47)	3 (33)	12 (18)			
Pacific Serviceberry	1 (57)	2 (16)	2 (54)	2 (26)		1 (20)
Creeping Snowberry			2 (18)	1 (60)		
Wood Rose			1 (18)	2 (46)	1 (14)	
Hazelnut				2 (40)		
Sadler Oak					37 (100)	
Red Huckleberry	1 (5)	2 (16)	5 (18)		4 (71)	
Slender Salal					4 (57)	
Buckbrush		4 (16)	3 (36)			24 (95)
Greenleaf Manzanita	2 (15)	2 (25)	7 (18)	2 (13)	1 (28)	5 (45)

PLANT ASSOCIATION:	PIJE/FEID	PIJE/QUVA-ARNE2/FEID	PIJE-PSME/QUVA/FECA	PIJE-ABCO/IRI	PIJE-ABCO/QUSA/XETE	PIJE-CADE3/CECU
	n=19	n=12	n=11	n=15	n=7	n=20
SHRUBS:	% COVER (CONSTANCY)					
Coffeeberry	2 (63)	1 (8)	5 (45)		1 (28)	3 (25)
Poison Oak						3 (30)
Siskiyou Mat		3 (50)	1 (9)			
Manzanita sp.						
Dwarf Oregongrape	1 (5)		1 (9)	1 (6)		
Dwarf Tanbark Oak		5 (18)				
Pink Honeysuckle						1 (5)
Toyon						5 (10)
Dwarf silktassel		4 (25)	5 (54)	1 (6)		
Pacific Rhododendron					40 (14)	10 (5)
Western Azalea						
Mountain Spirea						
Thinleaf Huckleberry						
Labrador Tea						
DelNorte Willow						
Salal						
Pacific Blackberry				1 (6)	1 (14)	
Pygmy Hollygrape						
California Bay (shrub)		10 (18)				
Creeping Oregongrape	2 (21)	1 (25)	1 (54)		1 (42)	
HERBS & GRASSES	% COVER (CONSTANCY)					
Idaho fescue	55 (100)	11 (100)	5 (36)			15 (55)
California fescue	9 (94)	19 (41)	33 (100)			11 (40)
Spreading Phlox	1 (31)	1 (50)	2 (18)			1 (5)
Stonecrop	1 (10)	1 (25)				1 (5)
Yarrow	1 (94)	1 (8)	1 (9)			1 (20)
Indian Paintbrush	1 (84)					
Beargrass	1 (5)		5 (54)		29 (100)	
Iris	1 (10)		1 (36)	1 (73)	1 (28)	1 (20)
White veined Wintergreen	1 (5)		1 (9)	1 (46)		

HERBS & GRASSES	% COVER (CONSTANCY)											
Bracken Fern					1	(9)	2	(40)	1	(57)		
White Hawkweed					1	(9)	1	(46)			1	(50)
Nootka Wintergreen					1	(9)	1	(13)	1	(57)		
Tolmie's startulip	1	(5)	1	(58)							1	(20)
Bedstraw			1	(36)								
Siskiyou Bedstraw			1	(41)							3	(5)
Bolander's Lily					1	(9)						
Common Whipplea					1	(9)			5	(5)		
Pipsissewa							2	(33)	1	(42)	1	(5)
Rattlesnake Plantain											1	(5)
Swordfern					1	(9)	1	(6)			1	(5)
Starflower					1	(36)	1	(6)				
Little Prince's Pine												
Western Fescue							5	(26)				
Sierra Milkwort											1	(10)
Threeleaf Anemone												
Blue Wild rye							1	(20)			12	(20)
Sedge									1	(14)	1	(5)
Heath Woodrush					1	(33)					1	(14)
Indian's dream	1	(78)	1	(33)	1	(9)						
Howell's Horkelia	20	(63)										
Wedgeleaf Violet												
Ternate Buckwheat												
Leafy Fleabane			1	(50)	3	(9)						
Northwestern Sedge												
Lemmon's Needlegrass												
California Pitcher-plant												
California Cone Flower												
Bog Asphodel												
Bigelow's Sneezeweed												

PLANT ASSOCIATION:	PIJE/FEID	PIJE/QUVA-ARNE2/FEID	PIJE-PSME/QUVA/FECA	PIJE-ABCO/IRI	PIJE-ABCO/QUSA/XETE	PIJE-CADE3/CECU
	n=19	n=12	n=11	n=15	n=7	n=20
HERBS & GRASSES	% COVER (CONSTANCY)					
Western Bog Violet						
California Lady Slipper						
Great Burnet						
Western Twinflower						
White Trillium						
Hooker's Fairy-bell	1 (5)			1 (13)		
Western Vancouveria						
Five Finger Fern						
Sharp Toothed Angelica						
Queen's Cup						
Oregon Trillium						
Vanilla Leaf						
Geyer's Oniongrass		1 (25)				

PLANT ASSOCIATION:	PIJE-CADE3/ CEPU1 n=11	PIJE-CADE3/ QUVA/XETE n=27	PIJE-CADE3- ABCO/QUVA n=17	PSME-UMCA1/ RHDI n=12	PSME-LIDE2/ QUVA-HODI n=4	PSME-CADE3/ FECA n=12
VEGETATION LAYER:			%COVER			
TOTAL COVER	64	76	86	87	95	91
GRASS COVER	3	1	1	3		66
FORB COVER	9	9	12	9	7	8
SHRUB COVER	34	60	52	19	76	4
TREE COVER	43	37	59	77	90	68
TREE OVERSTORY:		% COVER (CONSTANCY)				
Jeffrey Pine	25 (100)	17 (100)	23 (100)	15 (16)		5 (33)
Douglas-fir	18 (27)	6 (81)	17 (76)	50 (91)	64 (100)	42 (100)
Incense Cedar	10 (81)	8 (92)	14 (100)	5 (41)	15 (50)	18 (91)
Sugar Pine	2 (9)	12 (70)	7 (58)	3 (16)	18 (50)	3 (41)
California bay				36(100)		2 (25)
Western White Pine		2 (22)	8 (35)			
White Fir		1 (18)	8 (58)			
Pacific Madrone				11 (66)	4 (75)	10 (66)
Chinquapin						2 (25)
Lodgepole Pine						
Knobcone Pine		2 (25)				
Pacific Yew						
Port Orford Cedar		1 (3)				
Tanoak				9 (33)	20 (25)	2 (33)
White Alder						
Bigleaf Maple						
Canyon Live Oak				4 (16)		2 (33)
White Oak				2 (25)		9 (33)
Black Oak				3 (33)		1 (8)
Brewer's Spruce						
Red Fir						

TREE UNDERSTORY:	% COVER (CONSTANCY)					
Jeffrey Pine	6 (100)	1 (92)	2 (64)	1 (8)		1 (16)
Lodgepole Pine						
Douglas-fir	3 (27)	1 (66)	1 (47)	1 (75)	1 (100)	4 (100)
Incense Cedar	4 (100)	1 (85)	2 (82)	1 (50)	2 (50)	2 (91)
Sugar Pine	3 (18)	2 (55)	1 (52)		2 (50)	2 (33)
White fir	1 (18)	1 (25)	2 (88)			
Tanoak				2 (41)	38 (100)	2 (58)
White Oak	1 (9)			1 (16)		1 (25)
Black Oak						
California bay				10(100)		2 (50)
Canyon Live Oak	1 (9)			1 (50)		1 (66)
Chinquapin						
Western White Pine			1 (11)			
Pacific Yew						
Port Orford Cedar						
White Alder						
Bigleaf Maple						
SHRUBS:	% COVER (CONSTANCY)					
Squawcarpet		3 (37)	3 (17)			
Pinemat Manzanita		9 (72)	12 (58)			
Oceanspray			1 (11)	5 (16)	13 (75)	
Huckleberry Oak	1 (9)	52 (100)	43 (94)		34 (100)	2 (25)
Common Juniper						
Pacific Serviceberry	1 (18)	1 (25)	2 (58)	3 (16)	2 (75)	1 (16)
Creeping Snowberry	1 (9)		1 (11)			
Wood Rose				1 (16)	3 (100)	1 (25)
Hazelnut				5 (25)	1 (25)	
Sadler Oak		6 (22)	2 (11)			
Red Huckleberry		7 (44)	12 (17)		4 (100)	
Slender Salal						
Buckbrush		5 (14)		11 (25)		
Greenleaf Manzanita		3 (59)	3 (35)	1 (16)	1 (25)	

PLANT ASSOCIATION:	PIJE-CADE3/ CEPU1 n=11	PIJE-CADE3/ QUVA/XETE n=27	PIJE-CADE3- ABCO/QUVA n=17	PSME-UMCA1/ RHDI n=12	PSME-LIDE2/ QUVA-HODI n=4	PSME-CADE3/ FECA n=12
SHRUBS:	% COVER (CONSTANCY)					
Coffeeberry	13 (18)	1 (62)	1 (23)		5 (100)	
Poison Oak				6 (83)		1 (58)
Siskiyou Mat	29 (100)					
Manzanita sp.	3 (27)					
Dwarf Oregongrape					2 (100)	
Dwarf Tanbark Oak						
Pink Honeysuckle				2 (58)		1 (16)
Toyon				4 (41)		
Dwarf silktassel		3 (48)	2 (41)			
Pacific Rhododendron						
Western Azalea						
Mountain Spirea						
Thinleaf Huckleberry						
Labrador Tea						
DelNorte Willow						
Salal					2 (50)	
Pacific Blackberry						
Pygmy Hollygrape			1 (23)			1 (16)
California Bay (shrub)						
Creeping Oregongrape		1 (55)	1 (23)		1 (16)	
HERBS & GRASSES		% COVER (CONSTANCY)				
Idaho fescue		2 (14)	1 (11)			
California fescue	2 (9)		1 (5)	1 (33)		57 (100)
Spreading Phlox	1 (9)	1 (11)				
Stonecrop		1 (3)				
Yarrow	1 (18)			1 (16)		
Indian Paintbrush						
Beargrass	6 (18)	8 (81)	12 (76)		2 (100)	
Iris	1 (27)	1 (37)	1 (35)	2 (16)		1 (66)
White veined Wintergreen	1 (36)	1 (14)	1 (29)	1 (16)	1 (50)	

HERBS & GRASSES	% COVER (CONSTANCY)					
Bracken Fern						
White Hawkweed	6 (45)	1 (7)	1 (35)	1 (33)		1 (91)
Nootka Wintergreen	1 (9)	1 (25)	1 (41)			
Tolmie's startulip	1 (18)					
Bedstraw	1 (18)	1 (22)		1 (25)	1 (50)	
Siskiyou Bedstraw	1 (27)					
Bolander's Lily		1 (33)				
Common Whipplea		1 (25)		8 (16)	1 (75)	5 (41)
Pipsissewa	1 (9)	1 (11)	1 (70)	1 (16)	2 (100)	
Rattlesnake Plantain			1 (47)			1 (25)
Swordfern			1 (17)	6 (58)	3 (75)	1 (50)
Starflower		1 (18)	1 (23)	1 (41)	1 (75)	1 (33)
Little Prince's Pine			1 (17)		1 (25)	
Western Fescue				2 (16)		
Sierra Milkwort				1 (41)		
Threeleaf Anemone						
Blue Wild rye	1 (9)			1 (16)		3 (41)
Sedge	1 (9)	1 (40)	2 (17)		1 (50)	
Heath Woodrush		1 (3)				
Indian's dream	1 (9)			1 (33)		1 (25)
Howell's Horkelia						
Wedgeleaf Violet						
Ternate Buckwheat						
Leafy Fleabane						
Northwestern Sedge						
Lemmon's Needlegrass						
California Pitcher-plant						
California Cone Flower						
Bog Asphodel						
Bigelow's Sneezeweed						

PLANT ASSOCIATION:	PIJE-CADE3/ CEPU1 n=11	PIJE-CADE3/ QUVA/XETE n=27	PIJE-CADE3- ABCO/QUVA n=17	PSME-UMCA1/ RHDI n=12	PSME-LIDE2/ QUVA-HODI n=4	PSME-CADE3/ FECA n=12
HERBS & GRASSES			% COVER (CONSTANCY)			
Western Bog Violet						
California Lady Slipper						
Great Burnet						
Western Twinflower						
White Trillium						
Hooker's Fairy-bell			1 (11)			1 (50)
Western Vancouveria					3 (100)	
Five Finger Fern						
Sharp Toothed Angelica			1 (23)			
Queen's Cup						
Oregon Trillium						
Vanilla Leaf					1 (25)	
Geyer's Oniongrass						

PLANT ASSOCIATION:	PSME-PIJE/ FECA n=14	PSME/QUVA n=26	PSME/QUVA-LIDEE n=11	PSME/QUVA-RHMA n=4	CHLA/RHMA-GASH n=18	CHLA/RHOC n=13
VEGETATION LAYER:			%COVER			
TOTAL COVER	93	91	97	96	98	95
GRASS COVER	38	3	2	1	0	2
FORB COVER	6	14	12	10	8	6
SHRUB COVER	8	53	84	77	70	38
TREE COVER	77	60	49	66	79	77
TREE OVERSTORY:		% COVER (CONSTANCY)				
Jeffrey Pine	15 (92)	4 (19)	6 (27)			2 (15)
Douglas-fir	43 (100)	37 (100)	28 (100)	54(100)	32 (100)	24 (100)
Incense Cedar	13 (71)	5 (69)	3 (36)	5 (50)		
Sugar Pine	1 (7)	12 (88)	16 (81)	7 (75)	6 (33)	4 (61)
California bay	5 (14)					
Western White Pine			14 (18)	5 (50)		
White Fir	5 (14)		2 (18)		9 (11)	
Pacific Madrone	9 (71)	5 (42)	4 (27)	3 (50)	4 (11)	2 (30)
Chinquapin		4 (19)		3 (25)	8 (66)	1 (30)
Lodgepole Pine						
Knobcone Pine				1 (25)		
Pacific Yew					3 (22)	5 (15)
Port Orford Cedar				1 (25)	44 (100)	42 (100)
Tanoak	10 (28)	6 (34)	3 (9)		6 (22)	9 (61)
White Alder					5 (22)	
Bigleaf Maple		2 (3)				
Canyon Live Oak	15 (35)	1 (7)	10 (9)	5 (25)	3 (40)	
White Oak	3 (28)	3 (7)				
Black Oak	4 (21)					
Brewer's Spruce						
Red Fir						

TREE UNDERSTORY:	% COVER (CONSTANCY)					
Jeffrey Pine	1 (42)	1 (19)	1 (18)			
Lodgepole Pine						
Douglas-fir	2 (92)	2 (80)	2 (90)	1 (75)	3 (44)	2 (53)
Incense Cedar	2 (78)	1 (73)	1 (27)	1 (50)		
Sugar Pine	1 (21)	1 (46)	1 (81)	1 (25)	1 (11)	
White fir	1 (21)	2 (38)	1 (18)	1 (50)		2 (15)
Tanoak	5 (57)	8 (57)	17 (18)		2 (55)	2 (69)
White Oak	1 (14)					
Black Oak						
California bay	6 (42)		6 (63)			
Canyon Live Oak	2 (50)	10 (7)	10 (9)			
Chinquapin		5 (30)		1 (25)	3 (50)	2 (30)
Western White Pine				2 (25)		
Pacific Yew		7 (23)	1 (9)		2 (16)	
Port Orford Cedar	1 (7)				4 (100)	9 (100)
White Alder						
Bigleaf Maple						
SHRUBS:	% COVER (CONSTANCY)					
Squawcarpet						
Pinemat Manzanita		12 (15)	4 (27)			
Oceanspray	10 (7)	2 (15)	2 (27)	15 (25)		
Huckleberry Oak	5 (21)	39 (100)	52 (100)	19(100)	2 (16)	4 (53)
Common Juniper						
Pacific Serviceberry	1 (28)	2 (26)	7 (45)	3 (50)		
Creeping Snowberry	1 (35)	1 (15)				
Wood Rose	1 (42)	1 (30)	1 (72)	3(100)	1 (38)	1 (38)
Hazelnut	2 (28)					
Sadler Oak			5 (25)	7 (44)		
Red Huckleberry		11 (61)	13 (100)	15(100)	2 (100)	2 (76)
Slender Salal				4 (11)	1 (38)	
Buckbrush				1 (60)		
Greenleaf Manzanita	4 (14)	2 (19)				

PLANT ASSOCIATION:	PSME-PIJE/ FECA n=14	PSME/QUVA n=26	PSME/QUVA-LIDEE n=11	PSME/QUVA-RHMA n=4	CHLA/RHMA-GASH n=18	CHLA/RHOC n=13
SHRUBS:	% COVER (CONSTANCY)					
Coffeeberry	1 (21)		2 (63)			
Poison Oak	2 (50)					
Siskiyou Mat						
Manzanita sp.						
Dwarf Oregongrape	2 (14)	3 (57)		3 (50)	3 (55)	3 (38)
Dwarf Tanbark Oak			15 (81)	10(100)		
Pink Honeysuckle	2 (28)	1 (5)	1 (5)			
Toyon						1 (30)
Dwarf silktassel		4 (23)	5 (63)			
Pacific Rhododendron				13(100)	35 (100)	1 (30)
Western Azalea					4 (33)	24 (100)
Mountain Spirea					5 (80)	
Thinleaf Huckleberry					1 (10)	
Labrador Tea						
DelNorte Willow						
Salal				12 (50)	36 (94)	12 (46)
Pacific Blackberry		1 (23)	1 (27)	1 (50)	1 (27)	1 (76)
Pygmy Hollygrape	1 (21)		2 (72)	2 (25)		
California Bay (shrub)				10 (50)		
Creeping Oregongrape	1 (14)		2 (18)	2 (25)		
HERBS & GRASSES	% COVER (CONSTANCY)					
Idaho fescue	5 (7)		2 (25)			
California fescue	42 (85)					
Spreading Phlox						
Stonecrop						
Yarrow	1 (7)					
Indian Paintbrush						
Beargrass	2 (7)	6 (57)	2 (81)	5 (75)	3 (83)	2 (76)
Iris	1 (71)	1 (57)	1 (54)	1 (50)		
White veined Wintergreen	1 (21)	1 (34)	1 (63)			

HERBS & GRASSES	% COVER (CONSTANCY)					
Bracken Fern	1 (21)				1 (27)	
White Hawkweed	1 (64)	2 (26)				
Nootka Wintergreen		1 (19)	1 (63)			1 (15)
Tolmie's startulip						
Bedstraw		1 (19)	1 (18)			
Siskiyou Bedstraw		1 (3)	1 (27)			
Bolander's Lily		1 (11)	1 (45)	1 (25)		
Common Whipplea		6 (73)	6 (81)	2 (50)	1 (16)	1 (23)
Pipsissewa	2 (21)	2 (80)	2 (81)	3 (50)	3 (55)	1 (53)
Rattlesnake Plantain		1 (34)	1 (54)	1 (50)	1 (77)	1 (69)
Swordfern	2 (42)	2 (15)	4 (27)	2 (75)	1 (33)	1 (23)
Starflower	1 (35)	2 (57)	1 (54)	1 (25)	1 (33)	1 (38)
Little Prince's Pine	1 (28)					
Western Fescue	3 (28)	1 (23)	1 (27)	1 (50)		
Sierra Milkwort	1 (21)	2 (57)				
Threeleaf Anemone				1 (50)		
Blue Wild rye						
Sedge					3 (11)	2 (61)
Heath Woodrush						
Indian's dream						
Howell's Horkelia						
Wedgeleaf Violet						
Ternate Buckwheat						
Leafy Fleabane						
Northwestern Sedge						
Lemmon's Needlegrass						
California Pitcher-plant						
California Cone Flower						
Bog Asphodel						
Bigelow's Sneezeweed						

PLANT ASSOCIATION:	PSME-PIJE/ FECA	PSME/QUVA	PSME/QUVA-LIDEE	PSME/QUVA-RHMA	CHLA/RHMA-GASH	CHLA/RHOC
	n=14	n=26	n=11	n=4	n=18	n=13
HERBS & GRASSES	% COVER (CONSTANCY)					
Western Bog Violet						
California Lady Slipper						
Great Burnet						
Western Twinflower		6 (34)	2 (9)	1 (25)	3 (66)	1 (38)
White Trillium						1 (38)
Hooker's Fairy-bell	1 (21)	1 (26)	1 (27)	1 (50)	1 (11)	
Western Vancouveria						
Five Finger Fern						
Sharp Toothed Angelica						
Queen's Cup			1 (5)	1 (7)		
Oregon Trillium		2 (7)	1 (9)	1 (50)	1 (50)	
Vanilla Leaf	1 (7)	2 (34)		1 (25)		
Geyer's Oniongrass			1 (9)			

PLANT ASSOCIATION:	CHLA-PSME/ QUVA n=22	CHLA-CADE3- ALRH n=3	CHLA-PIMO3/ QUVA n=10	CHLA-ABCO/ QUVA n=10	CHLA-ABCO- PIMO3/QUVA n=10	CHLA-ABCO/ RHOC n=10
VEGETATION LAYER:			%COVER			
TOTAL COVER	91	94	93	93	92	92
GRASS COVER	1	2	5	1	1	1
FORB COVER	9	12	14	14	8	6
SHRUB COVER	33	9	67	19	52	41
TREE COVER	70	92	54	80	68	75
TREE OVERSTORY:		% COVER (CONSTANCY)				
Jeffrey Pine	13 (27)				10 (10)	1 (30)
Douglas-fir	26 (100)	30 (100)	14 (100)	30(100)	17 (100)	13 (100)
Incense Cedar	7 (40)	9 (100)	10 (20)	8 (60)	4 (50)	
Sugar Pine	7 (86)			10 (60)	4 (30)	9 (70)
California bay		4 (20)				
Western White Pine		6 (100)		11(100)		
White Fir			15 (100)	11 (80)	10 (100)	
Pacific Madrone	5 (31)	1 (33)	2 (50)	1 (20)		
Chinquapin		10 (33)		3 (20)		
Lodgepole Pine						
Knobcone Pine						
Pacific Yew		10 (33)				
Port Orford Cedar	29 (100)	35 (100)	28 (100)	28(100)	31 (100)	49 (100)
Tanoak	14 (22)	5 (33)				
White Alder		5 (100)				
Bigleaf Maple		5 (100)				
Canyon Live Oak						
White Oak						
Black Oak						
Brewer's Spruce					2 (30)	
Red Fir					2 (10)	5 (20)

TREE UNDERSTORY:% COVER (CONSTANCY)						
Jeffrey Pine	1 (22)					1 (10)
Lodgepole Pine						
Douglas-fir	1 (72)	5 (66)	2 (80)	2 (70)	1 (30)	1 (30)
Incense Cedar	1 (45)	2 (66)				
Sugar Pine	1 (45)			1 (40)		1 (20)
White fir	1 (31)			3(100)	2 (90)	2 (100)
Tanoak	5 (54)	3 (66)	9 (20)	2 (20)		
White Oak						
Black Oak						
California bay						
Canyon Live Oak		1 (66)				
Chinquapin				1 (20)		2 (30)
Western White Pine		1 (100)			1 (70)	
Pacific Yew	2 (36)		1 (20)	3 (30)		
Port Orford Cedar	3 (100)	4 (100)	3 (90)	2(100)	2 (100)	1 (100)
White Alder		3 (66)				
Bigleaf Maple		3 (66)				8 (80)
SHRUBS: % COVER (CONSTANCY)						
Squawcarpet	1 (13)					
Pinemat Manzanita	2 (22)			1 (30)		2 (20)
Oceanspray	3 (13)	2 (33)	5 (30)		8 (80)	
Huckleberry Oak	23 (100)	15 (33)	38 (100)	11(100)	29 (100)	4 (80)
Common Juniper						
Pacific Serviceberry	1 (31)		3 (40)	3 (30)		1 (30)
Creeping Snowberry						
Wood Rose	1 (45)	1 (33)	1 (30)	1 (40)	2 (60)	
Hazelnut		2 (33)			3 (30)	
Sadler Oak	2 (18)			1 (60)	4 (60)	1 (50)
Red Huckleberry	5 (81)	1 (33)	6 (80)	6 (70)	16 (20)	2 (50)
Slender Salal	1 (18)			5 (30)		
Buckbrush						
Greenleaf Manzanita	4 (13)				2 (20)	

PLANT ASSOCIATION:	CHLA-PSME/ QUVA n=22	CHLA-CADE3- ALRH n=3	CHLA-PIMO3/ QUVA n=10	CHLA-ABCO/ QUVA n=10	CHLA-ABCO- PIMO3/QUVA n=10	CHLA-ABCO/ RHOC n=10
SHRUBS: % COVER (CONSTANCY)						
Coffeeberry	2 (13)		5 (20)			
Poison Oak		3 (20)				
Siskiyou Mat			2 (50)			
Manzanita sp.		13 (60)				
Dwarf Oregongrape	2 (27)	3 (66)	4 (30)	2 (50)		
Dwarf Tanbark Oak			13 (60)		5 (20)	
Pink Honeysuckle						
Toyon						
Dwarf silktassel			1 (50)		7 (50)	
Pacific Rhododendron		1 (33)	16 (30)			
Western Azalea				7 (50)	32 (100)	
Mountain Spirea						
Thinleaf Huckleberry						
Labrador Tea						
DelNorte Willow						
Salal						
Pacific Blackberry	1 (31)	1 (66)		1 (50)		2 (70)
Pygmy Hollygrape		1 (20)		1 (40)		
California Bay (shrub)		7 (50)				
Creeping Oregongrape	1 (22)		1 (20)			
HERBS & GRASSES%COVER (CONSTANCY)						
Idaho fescue						
California fescue						
Spreading Phlox						
Stonecrop						
Yarrow						
Indian Paintbrush						
Beargrass	3 (40)		3 (80)	3 (70)	4 (90)	3 (40)
Iris	1 (63)		2 (100)	1 (60)	1 (60)	1 (20)
White veined Wintergreen	1 (22)		1 (30)	1 (30)	1 (40)	

HERBS & GRASSES% COVER (CONSTANCY)								
Bracken Fern							1 (20)	1 (40)
White Hawkweed					1 (50)		1 (20)	
Nootka Wintergreen			1 (30)		1 (30)		1 (30)	1 (20)
Tolmie's startulip								
Bedstraw								
Siskiyou Bedstraw								
Bolander's Lily								
Common Whipplea	2 (54)	10 (66)	5 (70)		2 (50)			1 (20)
Pipsissewa	1 (54)	1 (33)	2 (50)		2 (70)		2 (90)	1 (70)
Rattlesnake Plantain	1 (72)	1 (33)	1 (20)		1 (50)		1 (30)	1 (60)
Swordfern	1 (31)	2 (66)	2 (60)		1 (20)		1 (20)	
Starflower			1 (20)		1 (70)		1 (30)	
Little Prince's Pine	1 (18)						1 (20)	
Western Fescue	1 (9)				1 (10)		1 (30)	1 (20)
Sierra Milkwort	1 (45)							
Threeleaf Anemone					1 (20)		1 (30)	
Blue Wild rye								
Sedge	1 (18)		4 (30)		1 (20)		1 (30)	1 (50)
Heath Woodrush								
Indian's dream								
Howell's Horkelia								
Wedgeleaf Violet								
Ternate Buckwheat								
Leafy Fleabane								
Northwestern Sedge								
Lemmon's Needlegrass								
California Pitcher-plant								
California Cone Flower								
Bog Asphodel								
Bigelow's Sneezeweed								

PLANT ASSOCIATION:	CHLA-PSME/ QUVA n=22	CHLA-CADE3- ALRH n=3	CHLA-PIMO3/ QUVA n=10	CHLA-ABCO/ QUVA n=10	CHLA-ABCO- PIMO3/QUVA n=10	CHLA-ABCO/ RHOC n=10
HERBS & GRASSES% COVER (CONSTANCY)						
Western Bog Violet						
California Lady Slipper						
Great Burnet						
Western Twinflower		1 (66)	3 (60)	7 (60)	3 (40)	2 (40)
White Trillium				1 (30)	1 (30)	1 (30)
Hooker's Fairy-bell	1 (18)		1 (20)	1 (60)	1 (50)	
Western Vancouveria	1 (27)			1 (40)		
Five Finger Fern						1 (50)
Sharp Toothed Angelica				1 (50)	1 (20)	1 (30)
Queen's Cup				2 (30)	1 (50)	1 (40)
Oregon Trillium			1 (40)			
Vanilla Leaf	2 (18)			1 (20)		
Geyer's Oniongrass						

PLANT ASSOCIATION:	PILA-CACH2/ QUVA-QUSA n=10	PILA-PICO1/ QUVA-LIDEE n=10	PILA-PICO1/ LIDEE-RHMA n=6	PILA-PIMO3/ QUVA-GABU2 n=5	PIMO3-PILA/ QUVA-LIDEE n=10	PIMO3-PSME/ QUVA-LIDEE n=10
VEGETATION LAYER:	%COVER					
TOTAL COVER	95	91	92	89	95	88
GRASS COVER	1	2		1	1	6
FORB COVER	14	11	10	2	16	10
SHRUB COVER	76	76	82	74	84	67
TREE COVER	26	35	38	38	37	43
TREE OVERSTORY:	% COVER (CONSTANCY)					
Jeffrey Pine				5(100)		
Douglas-fir	4 (60)	4 (30)	5 (83)	5 (60)	6 (60)	5 (60)
Incense Cedar				5 (80)	1 (30)	
Sugar Pine	18 (100)	18 (100)	8 (100)	15(100)	11 (100)	
California bay						
Western White Pine	8 (20)	8 (50)	5 (33)	10(100)	24 (90)	20 (80)
White Fir						
Pacific Madrone						
Chinquapin	3 (50)					
Lodgepole Pine		23 (40)	42 (66)		2 (40)	32 (80)
Knobcone Pine	4 (20)	5 (30)			1 (40)	1 (30)
Pacific Yew						
Port Orford Cedar						
Tanoak	1 (20)					
White Alder						
Bigleaf Maple						
Canyon Live Oak	2 (20)					
White Oak						
Black Oak						
Brewer's Spruce	1 (20)					
Red Fir				1 (20)		

TREE UNDERSTORY:	% COVER (CONSTANCY)					
Jeffrey Pine			2 (60)			
Lodgepole Pine		2 (20)	1 (16)		1 (20)	1 (70)
Douglas-fir	1 (80)	1 (30)	1 (100)		1 (60)	1 (60)
Incense Cedar		3 (30)			2 (80)	1 (20)
Sugar Pine	2 (100)	3 (100)	1 (83)	1(100)	3 (100)	
White fir			1 (100)			
Tanoak			1 (40)			
White Oak						
Black Oak						
California bay						5 (30)
Canyon Live Oak						
Chinquapin	7 (60)					
Western White Pine		1 (50)	1 (33)	2(100)	4 (90)	5 (80)
Pacific Yew			1 (16)			
Port Orford Cedar		1 (10)				
White Alder						
Bigleaf Maple						

SHRUBS:	%COVER (CONSTANCY)					
Squawcarpet		4 (50)				6 (60)
Pinemat Manzanita	18 (100)	22 (80)	10 (23)	2 (60)	15 (90)	17 (90)
Oceanspray					3 (30)	3 (40)
Huckleberry Oak	18 (100)	22 (100)	20 (100)	54(100)	34 (100)	33 (90)
Common Juniper		4 (50)	4 (33)		3 (70)	5 (60)
Pacific Serviceberry		2 (60)	4 (83)	2 (60)	3 (40)	1 (50)
Creeping Snowberry						
Wood Rose			2 (50)	1 (20)	1 (30)	
Hazelnut						
Sadler Oak	8 (100)					
Red Huckleberry	7 (70)	8 (100)	8 (66)	7(100)	16 (100)	8 (90)
Slender Salal			15 (33)			
Buckbrush				5 (20)		
Greenleaf Manzanita	3 (20)	7 (50)	3 (33)		5 (20)	3 (30)

PLANT ASSOCIATION:	PILA-CACH2/ QUVA-QUSA n=10	PILA-PICO1/ QUVA-LIDEE n=10	PILA-PICO1/ LIDEE-RHMA n=6	PILA-PIMO3/ QUVA-GABU2 n=5	PIMO3-PILA/ QUVA-LIDEE n=10	PIMO3-PSME/ QUVA-LIDEE n=10
SHRUBS:	% COVER (CONSTANCY)					
Coffeeberry		3 (80)	3 (50)	5(100)	5 (90)	5 (70)
Poison Oak						
Siskiyou Mat			2 (16)	1 (20)		
Manzanita sp.						
Dwarf Oregongrape						
Dwarf Tanbark Oak	15 (70)	16 (100)	30 (100)		15 (90)	13 (90)
Pink Honeysuckle						
Toyon						
Dwarf silktassel		5 (80)	2 (16)	8(100)	7 (80)	4 (80)
Pacific Rhododendron	18 (40)		14 (100)			
Western Azalea			5 (50)		5 (30)	
Mountain Spirea						
Thinleaf Huckleberry						
Labrador Tea						
DelNorte Willow						
Salal	16 (50)		4 (33)			
Pacific Blackberry						
Pygmy Hollygrape						
California Bay (shrub)		6 (40)			5 (70)	5 (40)
Creeping Oregongrape		2 (40)	1 (16)		2 (90)	1 (50)
HERBS & GRASSES		%COVER (CONSTANCY)				
Idaho fescue						5 (50)
California fescue		1 (40)			2 (20)	6 (40)
Spreading Phlox						
Stonecrop						
Yarrow					1 (10)	
Indian Paintbrush				1 (20)	5 (40)	
Beargrass	13 (100)	11 (100)	9 (100)	2 (80)	12 (100)	7 (90)
Iris		2 (40)		1 (20)		2 (60)
White veined Wintergreen	1 (60)	1 (60)	1 (33)	1 (60)	1 (40)	1 (60)

PLANT ASSOCIATION:	PILA-CACH2/ QUVA-QUSA n=10	PILA-PICO1/ QUVA-LIDEE n=10	PILA-PICO1/ LIDEE-RHMA n=6	PILA-PIMO3/ QUVA-GABU2 n=5	PIMO3-PILA/ QUVA-LIDEE n=10	PIMO3-PSME/ QUVA-LIDEE n=10
HERBS & GRASSES	% COVER (CONSTANCY)					
Bracken Fern	1 (50)	1 (20)				
White Hawkweed						
Nootka Wintergreen					1 (20)	1 (10)
Tolmie's startulip					1 (10)	1 (10)
Bedstraw						
Siskiyou Bedstraw	1 (10)					
Bolander's Lily	1 (20)	1 (10)	1 (33)		1 (30)	1 (10)
Common Whipplea		1 (50)		4 (60)	3 (60)	
Pipsissewa	1 (20)	1 (40)	1 (16)	1 (60)	1 (30)	1 (20)
Rattlesnake Plantain						1 (10)
Swordfern						
Starflower		1 (20)			1 (20)	1 (20)
Little Prince's Pine						
Western Fescue						
Sierra Milkwort				1 (20)		
Threeleaf Anemone				1 (40)		
Blue Wild rye						
Sedge		4 (40)		1 (60)		1 (10)
Heath Woodrush	1 (10)		1 (33)		1 (10)	1 (20)
Indian's dream						
Howell's Horkelia			1 (16)			
Wedgeleaf Violet						
Ternate Buckwheat						
Leafy Fleabane						
Northwestern Sedge						
Lemmon's Needlegrass						
California Pitcher-plant						
California Cone Flower						
Bog Asphodel						
Bigelow's Sneezeweed						

PLANT ASSOCIATION:	PILA-CACH2/ QUVA-QUSA n=10	PILA-PICO1/ QUVA-LIDEE n=10	PILA-PICO1/ LIDEE-RHMA n=6	PILA-PIMO3/ QUVA-GABU2 n=5	PIMO3-PILA/ QUVA-LIDEE n=10	PIMO3-PSME/ QUVA-LIDEE n=10
HERBS & GRASSES		% COVER (CONSTANCY)				
Western Bog Violet						
California Lady Slipper						
Great Burnet						
Western Twinflower						1 (10)
White Trillium						
Hooker's Fairy-bell						
Western Vancouveria						
Five Finger Fern						
Sharp Toothed Angelica						
Queen's Cup						
Oregon Trillium					1 (10)	
Vanilla Leaf						
Geyer's Oniongrass						

PLANT ASSOCIATION:	PIMO3-PICO1/ LIDEE-RHMA	CEPU/FEID	DACA2//BOG
	n=10	n=10	n=10
VEGETATION LAYER:		%COVER	
TOTAL COVER	94	63	87
GRASS COVER	2	21	26
FORB COVER	23	20	43
SHRUB COVER	77	16	14
TREE COVER	48	3	14
TREE OVERSTORY:	% COVER (CONSTANCY)		
Jeffrey Pine		4 (60)	1 (20)
Douglas-fir	5 (60)	2 (10)	
Incense Cedar		1 (10)	
Sugar Pine			
California bay			
Western White Pine	21 (100)	1 (20)	4 (100)
White Fir			
Pacific Madrone			
Chinquapin			
Lodgepole Pine	30 (80)		5 (30)
Knobcone Pine			
Pacific Yew			
Port Orford Cedar	2 (20)		4 (90)
Tanoak			
White Alder			
Bigleaf Maple			
Canyon Live Oak			
White Oak			
Black Oak			
Brewer's Spruce			
Red Fir			

TREE UNDERSTORY:	% COVER (CONSTANCY)		
Jeffrey Pine		1 (60)	
Lodgepole Pine	4 (60)	1 (10)	1 (30)
Douglas-fir	1 (50)		
Incense Cedar			
Sugar Pine			
White fir			
Tanoak			
White Oak			
Black Oak			
California bay			
Canyon Live Oak			
Chinquapin			
Western White Pine	4 (90)		2 (90)
Pacific Yew			
Port Orford Cedar	5 (20)		3 (90)
White Alder			
Bigleaf Maple			
SHRUBS:	% COVER (CONSTANCY)		
Squawcarpet			
Pinemat Manzanita	16 (70)	9 (60)	
Oceanspray	3 (90)	1 (30)	
Huckleberry Oak	12 (100)	4 (60)	
Common Juniper	6 (80)	4 (80)	
Pacific Serviceberry	2 (40)	1 (30)	
Creeping Snowberry			
Wood Rose	1 (30)		
Hazelnut			
Sadler Oak			
Red Huckleberry	10 (100)		1 (30)
Slender Salal			
Buckbrush			
Greenleaf Manzanita	3 (20)		

	PIMO3-PICO1/ LIDEE-RHMA n=10	CEPU/FEID n=10	PITCHER PLANT BOG n=10
SHRUBS:	% COVER (CONSTANCY)		
Coffeeberry	6 (90)	1 (20)	1 (60)
Poison Oak			
Siskiyou Mat		3 (100)	
Manzanita sp.			
Dwarf Oregongrape			
Dwarf Tanbark Oak	31 (90)		2 (60)
Pink Honeysuckle			
Toyon			
Dwarf silktassel		2 (40)	1 (20)
Pacific Rhododendron	16 (90)		
Western Azalea	11 (70)		8 (90)
Mountain Spirea			
Thinleaf Huckleberry			
Labrador Tea			5 (80)
DelNorte Willow			1 (10)
Salal			
Pacific Blackberry			
Pygmy Hollygrape			
California Bay (shrub)	6 (40)	1 (20)	1 (20)
Creeping Oregongrape	3 (20)		
HERBS & GRASSES	% COVER (CONSTANCY)		
Idaho fescue		16 (100)	1 (10)
California fescue	3 (30)		
Spreading Phlox		1 (40)	
Stonecrop		1 (40)	
Yarrow		1 (20)	
Indian Paintbrush		1 (20)	
Beargrass	19 (100)		1 (10)
Iris	1 (30)		
White veined Wintergreen	2 (50)		

HERBS & GRASSES	% COVER (CONSTANCY)		
Bracken Fern			
White Hawkweed			
Nootka Wintergreen			
Tolmie's startulip		2 (40)	
Bedstraw			
Siskiyou Bedstraw	1 (20)		
Bolander's Lily		1 (20)	
Common Whipplea	2 (40)		1 (10)
Pipsissewa			
Rattlesnake Plantain			
Swordfern			
Starflower			
Little Prince's Pine			
Western Fescue			
Sierra Milkwort			1 (10)
Threeleaf Anemone			
Blue Wild rye		1 (10)	
Sedge	3 (30)		
Heath Woodrush	1 (10)		
Indian's dream		1 (50)	
Howell's Horkelia		7 (80)	
Wedgeleaf Violet		2 (70)	
Ternate Buckwheat		2 (50)	
Leafy Fleabane		1 (50)	
Northwestern Sedge		4 (90)	
Lemmon's Needlegrass		3 (50)	
California Pitcher-plant			32 (100)
California Cone Flower			2 (90)
Bog Asphodel			2 (80)
Bigelow's Sneezeweed			2 (70)

APPENDIX VI :PLANT ASSOCIATION & RARE PLANT MATRIX

SENSITIVE PLANTS:	//SERPENTINE BARRENS	DACA2/BOG	PIJE/FEID	PIJE/QUVA-ARNE2/FEID	PIJE-PSME/QUVA/FECA	PIJE-ABCO/IRI	PIJE-ABCO/QUSA/XETE	PIJE-CADE3/CECU-2	PIJE-CADE3/CEPU	PIJE-CADE3/QUVA/XETE	PIJE-CADE3-ABCO/QUVA	PSME-UMCA/RHDI	PSME-LIDE2/QUVA-HODI
Arabis aculeolata	X			X									
Arabis koehleri var. stipitata	X			X									
Arabis macdonaldiana	X		X	X									
Arabis serpentinicola	X												
Arctostaphylos canescens ssp. sonomensis													
Cardamine nuttalli var. *gemmata*	X		X	X									
Castilleja miniata ssp. *elata*		X											
Dicentra formosa ssp. *oregana*			X										
*Draba carnosula**													
*Epilobium oreganum**													
*Epilobium siskiyouense**													
Eriogonum pendulum	X		X	X									
Gentiana setigera		X											
Lathyrus biflorus	X												
Lewisia oppositifolia	X												
Lupinus constancei	X												
Minuartia decumbens	X								X				
Sanguisorba officianalis		X											
Sedum laxum ssp. *flavidum*	X		X	X						X			
Streptanthus howellii				X									
*Thlaspi californicum**													
Viola primulifolia ssp.*occidentalis*		X											
RARE SPECIES:													
Allium hoffmani	X								X				
Allium siskiyouense	X			X									
Antennaria suffrutescens	X		X							X			
Arctostaphylos hispidula	X		X										
Arnica cernua	X		X							X			
Arnica spathulata	X												
*Calamagrostis crassiglumis**													
Castilleja hispida ssp. *brevilobata*	X		X										
Cypripedium californica		X											
Darlingtonia californica		X											
Epilobium rigidum	X												
Erigeron bloomeri var. *nudatus*	X												
Eriogonum ternatum	X												
Erythronium citrinum var. *citrinum*													

	PSME-CADE3/FECA
	PSME-PIJE/FECA
X	PSME/QUVA
	PSME/QUVA-LIDEE
	PSME/QUVA-RHMA
	CHLA/RHMA-GASH
X	CHLA/RHOC
	CHLA-PSME/QUVA
	CHLA-CADE3-ALRH
X	CHLA-PIMO3/QUVA
	CHLA-ABCO/QUVA
	CHLA-ABCO-PIMO3/QUVA
	CHLA-ABCO/RHOC
	PILA-CACH2/QUVA-QUSA
	PILA-PICO1/QUVA-LIDEE
	PILA-PICO1/LIDEE-RHMA
	PILA-PIMO3/QUVA-GABU2
X	PIMO3-PILA/QUVA-LIDEE
X	PIMO3-PSME/QUVA-LIDEE
	PIMO3-PICO1/LIDEE-RHMA

	//SERPENTINE BARRENS	DACA2/BOG	PIJE/FEID	PIJE/QUVA-ARNE2/FEID	PIJE-PSME/QUVA/FECA	PIJE-ABCO/IRI	PIJE-ABCO/QUSA/XETE	PIJE-CADE3/CECU-2	PIJE-CADE3/CEPU	PIJE-CADE3/QUVA/XETE	PIJE-CADE3-ABCO/QUVA	PSME-UMCA/RHDI	PSME-LIDE2/QUVA-HODI
Horkelia sericata	X		X	X									
Iris innominata	X		X									X	
Lathyrus delnorticus													
Lilium bolanderi					X	X							
Lilium washingtonianum ssp. purparescens						X					X		
Lilium pardilinum ssp. *volmeri*		X											
Lomatium howellii	X		X	X		X							
*Lomatium tracyi**													
Minuartia howellii	X		X	X									
Pinguicula vulgaris ssp. *macroceras*		X											
Poa piperi	X		X										
Pyrrocoma racemosa var. *congesta*			X										
Salix delnortensis													
Sanicula peckiana	X		X	X		X							
Sedum laxum ssp. *heckneri*	X		X	X									
Senecio macounii			X										
*Tauschia glauca**													
Vancouveria chrysantha				X									

PSME-CADE3/FECA																				X			
PSME-PIJE/FECA																		X					
PSME/QUVA	X																	X					
PSME/QUVA-LIDEE						X												X					
PSME/QUVA-RHMA	X					X			X														
CHLA/RHMA-GASH																							
CHLA/RHOC																							
CHLA-PSME/QUVA																							
CHLA-CADE3-ALRH																							
CHLA-PIMO3/QUVA																							
CHLA-ABCO/QUVA																							
CHLA-ABCO-PIMO3/QUVA																							
CHLA-ABCO/RHOC																							
PILA-CACH2/QUVA-QUSA																		X		X			
PILA-PICO1/QUVA-LIDEE																		X					
PILA-PICO1/LIDEE-RHMA																X		X					
PILA-PIMO3/QUVA-GABU2																X							
PIMO3-PILA/QUVA-LIDEE			X		X				X			X		X				X					
PIMO3-PSME/QUVA-LIDEE	X		X		X													X	X	X	X		
PIMO3-PICO1/LIDEE-RHMA	X		X													X		X		X	X		

* Species for which a tie to Plant Association is lacking.

APPENDIX VII: PLANTS ON THE SISKIYOU,KLAMATH AND SHASTA TRINITY NATIONAL FOREST'S SENSITIVE PLANT LISTS WHICH OCCUR ON SERPENTINE PARENT MATERIAL

Plants on the Siskiyou National Forest Sensitive Plant List which occur on serpentine parent materials.

Scientific Name	*Common Name*
Allium bolanderi var. *mirabile*	Bolander's onion
*Arabis aculeolata**	Waldo rock cress
*Arabis macdonaldiana**	Macdonld's rock cress
*Arabis serpentinicola**	Preston Peak rock cress
Arctostaphylos hispidula?*	Howell's manzanita
Calochortus howellii	Howell's mariposa lily
Camassia howellii	Howell's camas
*Carex gigas**	Siskiyou sedge
Carex livida	pale sedge
Cardamine nuttallii var. *gemmata**	Purple toothwort
Castilleja miniata ssp. *elata*?*	Siskiyou indian paintbrush
Cupressus bakeri?*	Baker's cypress
*Epilobium rigidum**	Siskiyou Mtn. willow herb
*Epilobium oreganum**	Oregon fireweed
Erigeron bloomeri var. *nudatus**	Waldo daisy
*Erigeron cervinus**	Siskiyou daisy
Eriogonum diclinum	Jaynes canyon buckwheat
*Eriogonum pendulum**	Waldo buckwheat
*Erythronium howellii**	Howell's fawn lily
*Fritillaria glauca**	Siskiyou fritillary
*Gentiana setigera**	Mendocino gentian
*Hastingsia bracteosa**	Large-flowered rush lily
Hieracium bolanderi	Bolander's hawkweed
*Lewisia oppositifolia**	Opposite-leaved lewisia
Limnanthes gracilis var. *gracilis*	Slender meadow-foam
*Lomatium engelmannii**	Engelmann's desert parsley
Microseris howellii	Howell's microseris
Mimulus douglasii	Douglas's monkeyflower
*Monardella purpurea**	Siskiyou monardella
Perideridia erythrorhiza	Red-root yampah
*Poa piperi**	timber bluegrass
*Salix delnortensis**	Del Norte willow
*Sanicula peckiana**	Peck's snake-root
Senecio hesperius	Siskiyou butterweed
*Streptanthus howellii**	Howell's jewel flower
Viola primulifolia ssp. *occidentalis**	Western bog violet

* Taxa which occur in California

? Questionable site or documentation poor in Oregon

Plants on the Klamath National Forest Sensitive Plant List which occuron serpentine parent materials.

Scientific Name	*Common Name*
Arabis aculeolata	Waldo rock cress
Arabis serpentinicola	Preston Peak rock cress
Castilleja miniata ssp. *elata*?	Siskiyou indian paintbrush
Draba carnosula	Mt. Eddy draba
Epilobium siskiyouense	Siskiyou fireweed
Eriogonum alpinum	Trinity buckwheat
Eriogonum hirtellum	Klamath Mtn. buckwheat
Galium serpenticum ssp. *scotticum*	Scott Mountain bedstraw
Ivesia pickeringii	Pickering's ivesia
Pedicularis howellii	Howell's lousewort
Perideridia leptocarpa	narrow-seeded yampah
Phacelia dalesiana	Scott Mtn. phacelia
Phacelia greenei	Scott Valley phacelia
Phlox hirsuta	Yreka phlox
*Potentialla cristae***	crested potentilla
Raillardella pringlei	showy raillardella
Sedum laxum ssp. *flavidum*	pale yellow stonecrop

? Questionable site or documentation poor

** Not currently on Regional Sensitive Plant list; recommended for addition.

Plants on the Shasta Trinity National Forest Sensitive Plant List(except where noted) which occur on serpentine parent materials.

Scientific Name	*Common Name*
Arctostaphylos klamathensis	Klamath manzanita
Campanula wilkinsiana	Wilkins' harebell
*Chaenactis suffrutescens***	Shasta chaenactis
Draba aureola	golden draba
Draba carnosula	Mt. Eddy draba
*Epilobium oreganum***	Oregon fireweed
Epilobium siskiyouense	Siskiyou fireweed
Eriogonum alpinum	Trinity buckwheat
Eriogonum umbellatum ssp. *humistratum*	Mt. Eddy buckwheat
Erythronium citrinum var. *roderickii*	Scott Mtn. fawn lily
Galium serpenticum ssp. *scotticum*	Scott Mtn. bedstraw
Ivesia pickeringii	Pickering's ivesia
Lewisia cotyledon var. *heckneri*	Heckner's lewisia
Linanthus nuttallii ssp. *howellii*	Howell's linanthus
Madia doris-nilesia	Niles' madia
Madia stebbinsii	Stebbin's madia
Minuartia rosei	peanut sandwort
*Minuartia stolonifera***	Scott Mtn. sandwort
Penstemon filiformis	thread-leaved beardtongue
Phacelia dalesiana	Scott Mtn. phacelia
Phacelia greenei	Scott Valley phacelia
*Phacelia leonis***	Siskiyou phacelia
*Potentilla cristae***	crested potentilla
Raillardella pringlei	showy raillardella
Sedum laxum ssp. *flavidum*	pale yellow stonecrop

**Not currently on Regional Sensitive Plant List; recommended for addition

APPENDIX VIII: SENSITIVE & RARE PLANT STATUS DEFINITIONS

Federal Status terminolgy under the Endangered Species Act(Skinner and Pavlik 1994)

Federally Listed Species:

ENDANGERED SPECIES are any species, including subspecies, "in danger of extinction throughout all or a significant portion of its range. The US Fish & Wildlife Service considers varieties to be equivalent to subspecies and thus these are also covered under the Act".

THREATENED SPECIES are "likely to become an endangered species within the foreseeable future throughtout all or a significant portion of its range".

"***Federally-listed species***" or "***listed***" species have been designated as endangered or threatened through publication of a final rule in the Federal Register.

Proposed Listed Species:

Category 1 candidates are "taxa for which the US Fish & Wildlife Service currently has on file substantial information on biological vulnerability [relating to autecology and distribution] and threat(s) to support the appropriateness of propsing to list the taxa as endangered or threatened species."

Category 2 candidates are "taxa for which information now in the posession of the US Fish & Wildlife Service indicates that proposing to list them as endangered or threatened species is prossibly appropriate, but for which substantial data on biological vulnerability and threat(s) are not currently known or on file to support the immediate preparation of rules."

Category 3 consists of non-candidates, plants previously considered candidates and included on past lists. These former candidate plants have been grouped into three sub-categories:

3A extinct.

3B taxonomically invalid or not meeting the US Fish & Wildlife Service's definition of a species.

3C too widespread or not threatened at this time.

"Proposed species" have had regulation proposed, but no final ruling has been posted in the Federal Register.

Definition of the State categories rare, threatened and endangered(Skinner and Pavlik 1994)

RARE A plant that is "not presently threatened with extinction, [but] is in such small numbers throughout its range that it may become endangered if its present environment worsens."

THREATENED A plant that is not "presently threatened with extinction, [but] is likely to become an endangered species in the foreseeable future in the absence of special protection and management efforts..."

ENDANGERED A plant whose "prospects of survival and reproduction are in immediate in jeopardy from one or more causes."

Definitions of California State Ranking Codes.

S1 Critically imperiled in state because of extreme rarity or some factor making it especially vulnerable to extirpation from state; typically 5 or fewer occurrences in state.

S2 Imperiled in state because of rarity or some factor making it very vulnerable to extirpation from state; typically 6 to 20 occurrences in state.

S3 Rare or uncommon, typically 21-100 occurrences in state, may be somewhat vulnerable toextirpation.

S4 Apparently secure in state.

S5 Very common and demonstrably secure in state.

SH Of historical occurrence in state, possibly extirpated from state (not recently reported but worth further searching).

SX Believed extirpated from state.

SR Reported for state, but without persuasive documentation which would provide a basis for either accepting or rejecting the report.

SRF Reported falsely (in error) from state and this error persists in the literature.

S? Unranked or, if following a ranking, rank uncertain (S2?).

Definitions of Global Ranking Codes(Crouch 1992)

G1	Critically imperiled globally because of extreme rarity. Typically 5 or fewer known extant occurrences or very few remaining individuals.
G2	Imperiled globally because of rarity. Typically 6 to 20 extant occurrences or few remaining individuals.
G3	Either very rare and local throughout its range or found locally in a restricted range. Typically 21-100 extant occurrences.
G4	Apparently secure globally.
G5	Widespread, abundant and demonstrably secure globally.
GH	Of historical occurrence throughout its range, possibly extinct. No occurrences known extant. Typically not reported in the last 20 years but worth further searching.
GX	Presumed extinct throughout it's range.
GU	Possibly in peril range-wide but status uncertain; Unrankable without further information.
G?	Unranked, or, if following a ranking, rank uncertain (G3?).
G#Q	Taxonomically questionable.
G#T#	Rank of subspecies or variety ("Subrank" T1 - T5) is attached to the global rank of the full species.

Definition of the California Native Plant Society's (CNPS) Lists(Skinner and Pavlik 1994)

CNPS List 1B	Plants considered rare or endangered in California and elsewhere.
CNPS List 2	Plants considered rare, threatened, or endangered in California, but more common elsewhere.
CNPS List 3	Plants which need more information.
CNPS List 4	Plants of limited distribution - a watch list.

Definition of the California Native Plant Society's (CNPS) R-E-D Codes.

R(RARITY)

1 - Rare, but found in sufficient numbers and distributed widely enough that the potential for extinction is low at this time.

2 - Occurrence confined to several populations or to one extended population.

3 - Occurrence limited to one or a few highly restricted populations, or present in such small numbers that it is seldom reported.

E(ENDANGERMENT)

1 - Not endangered.

2 - Endangered in a portion of its range.

3 - Endangered throughout its range.

D(DISTRIBUTION)

1 - More or less widespread outside California.

2 - Rare outside California.

3- Endemic to California.

APPENDIX IX: BOTANICAL AREAS OF THE KLAMATH, SHASTA-TRINITY, AND SISKIYOU NATIONAL FORESTS FEATURING SERPENTINE HABITATS

KLAMATH NATIONAL FOREST

Name:	Acres:	Community:
China Mountain	900	High elevation, whitebark pine/foxtail community.
Cook and Green Pass	200	Peridotite environment, plant diversity.
Cory Peak	400	Serpentine crest, rare plant species.
Kangaroo Lake	400	Scott Mountains crest, bog habitat and rare plant species.
Red Mountain	400	Siskiyou crest, serpentine endemics
Rock Fence Creek	100	Scott Mountains, serpentine riparian community.
Scott Mountain	500	Crest zone, bog habitat, serpentine endemics.

SHASTA TRINITY NATIONAL FOREST

Name:	Acres:	Community:
China Mountain	680	High elevation whitebark pine/foxtail pine community.
Cory Peak	280	High elevation serpentine habitat, endemic and sensitive plants (borders with Klamath National Forest).
Deadfall Basin	460	Summit of Mt. Eddy, peridotite, subalpine vegetation, several rare and sensitive plants.
Dobkins/Durney Basin	--	North slope of Mt. Eddy, high concentration (proposed) of sensitive plants on serpentine.
Dubakella Mountain	--	Floristic diversity, high number of rare and (proposed) Endemic endemic serpentine plants.
Kangaroo Ridge	190	Concentration of rare and sensitive plants (borders with Klamath National Forest).
Scott Mountain	128	Scott Mtn. crest with Darlingtonia seeps and several serpentine endemic sensitive plants.
Tedoc Mountain	1,060	Highly serpentinized peridotite with various plant communities, several endemic sensitive plants.
Toad Lake	650	Lake and wet meadow vegetation on serpentine, concentration of sensitive plants.

SISKIYOU NATIONAL FOREST

Name:	Acres:	Community:
Big Craggies	3,803	Peridotite, very steep terrain (cliffs and talus), originally established in 1964 to protect Brewer's spruce and kalmiopsis.
Chrome Ridge	589	High elevation, open peridotite, scattered Jeffrey pine and shrubs, includes Darlingtonia fens; Brewer's spruce and kalmiopsis.
Days Gulch	1,252	Open Jeffrey pine savannah, includes Darlingtonia fens, a pond, and many local endemic serpentine species.
Eight Dollar	2,738	Variety of serpentine habitats, elevations and aspects, very high concentration of candidate and rare plants.
Iron Mountain	1,866	Serpentine and peridotite with granitics, greenstone and marble; range of approximately 70 species do not extend beyond this area.
Oregon Mountain	2,623	Serpentine band the West Fork of the Illinois River supports a numerous serpentine endemics and rare species.
Red Flat	53	Consists of Forest Service portion of this fen's watershed (fen is on BLM).
Rough and Ready	1,499	Alluvial flats, steep hillsides and a variety of serpentine habitats.
Snow Camp	1,041	Varied ultramafic and metavolcanic geology; meadow, fens, and includes non-serpentine rare plants (large population of bensonia).
Sourgame	572	Serpentine wetlands and meadows, variety of soils types/contact zones. Includes non-serpentine rare plants.
Vulcan Lake	133	High elevation serpentine east of Vulcan Lake.
York Creek	320	Peridotite and serpentine riparian.

APPENDIX X:GLOSSARY

GENERAL GLOSSARY

Definitions. The following definitions are used throughout the Pacific Southwest Region of the Forest Service to standardize the approach to its hierarchical vegetation classification. At the top of the vegetation hierarchy is the series. Series are identified by the presence of the dominant species in all or most of the structural layers present in late seral stage stands. Series are followed in the hierarchy by the sub-series. Here the series name is modified by the addition of a second species that has indicator value across multiple plant associations. At the bottom of the classification hierarchy the finest vegetation units described are plant associations. They are the potential natural community with uniform appearance and definite floristic composition.

COARSE FILTER ANALYSIS: A type of ecological analysis that focuses on entire communities of organisms, rather than individual ones.

CHARACTERISTIC COVER: The percent cover one could expect to find in a plant association if a species were present. It is calculated by summing percent cover and dividing by the number of plots containing the species.

CONSTANCY: The percent of times a species was found to occur in a plant association.

ECOSYSTEM MANAGEMENT: The skillful, integrated use of ecological knowledge at various scales to produce desired resource values, products, services and conditions in ways that also sustain the diversity and productivity of ecosystems (Manley and others 1995).

ECOLOGICAL TYPE: A category of land having a unique combination of potential natural community, soil, landscape features, climate, and differing from other ecological types in its ability to produce vegetation and respond to management.

ENDEMIC: A taxonomic category of organisms whose natural occurrence is confined to a certain region and whose distribution is relatively limited.

FINE FILTER ANALYSIS: A type of ecological analysis that focuses on conserving individual species, rather than on entire communities of organisms.

INDICATOR SPECIES: A species which is sensitive to important environment features of a site such that its constancy or abundance reflect significant changes in environment.

PLANT ASSOCIATION: A potential natural plant community of definite floristic composition and uniform appearance that repeats itself across the landscape and takes the name of the projected climax type.

PRIMARY REGENERATING SPECIES: The species which is higher in cover, or in number of individual stems, than any other species of the principle vegetative layer.

POTENTIAL NATURAL VEGETATION: The biotic community that would be established if all successional sequences of its ecosystem were completed without additional human-caused disturbance under present environmental conditions.

RARE PLANT: A term applied to California native plant species that are limited in their distribution or population abundence.

REPRODUCING SUCCESSFULLY: The species is present throughout the structural layers which are represented in the late seral stand.

SENSITIVE PLANT: A USDA Forest Service term used to designate plant species known or suspected to occur on National Forest system lands. This typically includes rare species included on Federal or State lists and/ or the California Native Plant Society list 1B.

SERIES :A vegetation series is an aggregation of taxonomically related plant associations which take the name of the (climatic) climax species that dominate (or have the potential to dominate) the principal vegetation layer in a time frame appropriate to the vegetation or taxonomic group under consideration.

SUB-SERIES: A vegetation sub-series is an aggregation of taxonomically related plant associations within a series that takes the name of that series followed by related species that are dominant, or have indicator value across multiple.

Glossary of Botanical Terms used in the Serpentine Guide

(Hickman 1993)

Achene	A small, dry indehiscent, one-seeded fruit.
Ascending	Curving or angling upward from base
Awl-like	Narrow throughout, but broader at the base, tapering to tip.
Basal	Situated at the base of the plant.
Biternate	Twice repeatedly lobed into three parts.
Calyx	Collective term for sepal; outermost whorl of flower parts.
Capsule	A dry, dehiscent many-seeded fruit composed of more than one carpel.
Caudex	Short, woody, vertical stem of a perennial, at or beneath the ground.
Cauline	Arising from the stem, not basal.
Ciliate	Having straight hairs along the margin or edge.
Crenate	Scalloped, shallow, rounded teeth.
Decumbent	Lying flat on the ground with tips curving up.
Dehiscent	Splitting open at maturity to release contents.
Dentate	Having margins with sharp teeth pointing outward.
Dissected	Deeply divided into numerous fine segments.
Entire	Having margins that are continuous and smooth.
Elliptical	In the form of a flattened circle more than twice as long as broad.
Erect	Upright.
Follicle	Dry, generally many-seeded fruit, dehiscent on only one side, along a single suture.
Fusiform	Elongate, widest at the middle, taped at both ends.
Glabrous	Without hairs.
Glandular	Having small, spherical bodies that exude a sticky substance.
Glaucous	Covered with whitish or bluish film.
Inflorescence	The flower cluster of a plant.
Lanceolate	Lance shaped, much longer than broad, tapering from below the middle to the apex and to the base.
Leaflet	A segment of a compoung leaf.
Linear	Elongate, with parallel sides.
Margin	The edge of the leaf.
Oblanceolate	Inversely lanceolate.
Obovate	Inversely ovate.
Ovate	Egg-shaped.
Pedicel	Stalk of an individual flower or fruit.
Pendent	Drooping or suspended from a point of attachment.
Petiole	Leaf stalk.

Perennial	Living more than two years or growing seasons.
Puberulent	Having hairs normally visible only when magnified.
Rhizome	Underground, elongate stem.
Rosette	A whorl of radiating leaves arising from the stem base.
Sepal	A member of the calyx.
Sessile	Attached directly at the base, without a stalk.
Silique	A narrow, many seeded, capsule common to the mustard family.
Strigose	Having stiff, sharp, appressed hairs.
Sub-palmate	Almost radiating from a common point.
Sub-shrub	A plant with the lower stems woody, upper stems not woody.
Winged	Thin, flat extension of a surface or margin.

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HERBS & GRASSES	PIMO3-PICO1/ LIDEE-RHMA n=10	CEPU/FEID n=10	PITCHER PLANT BOG n=10
	% COVER (CONSTANCY)		
Western Bog Violet			3 (70)
California Lady Slipper			1 (50)
Great Burnet			1 (50)
Western Twinflower			
White Trillium			
Hooker's Fairy-bell			
Western Vancouveria			
Five Finger Fern			
Sharp Toothed Angelica			
Queen's Cup			
Oregon Trillium			
Vanilla Leaf			
Geyer's Oniongrass			